DRAFT

FINAL GROUND-WATER ASSESSMENT FOR THE ALCOA-DAVENPORT WASTE SITE

TABLES AND FIGURES

AND

APPENDIX A-G

Submitted to:

Alcoa Davenport
Riverdale, Iowa

February 1990

Submitted to:

GERAGHTY & MILLER, INC.
Environmental Services

Dublin, Ohio

35858

332

FIGURES

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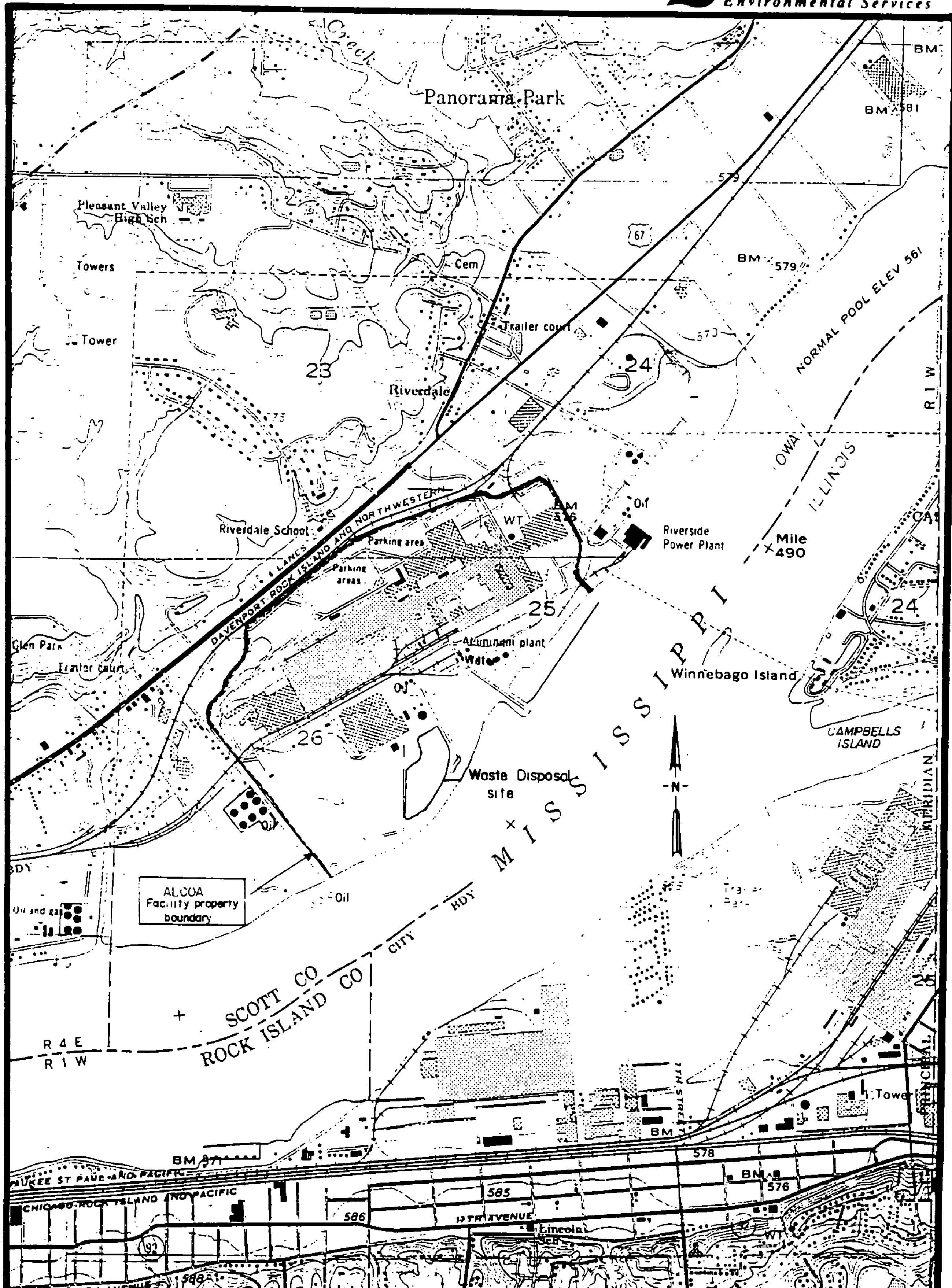


MAP FROM USGS SILVIS QUAD.

0 — 1/2 — 1 mile
SCALE

Figure 1. Location and Physical Setting of the Alcoa-Davenport Plant.

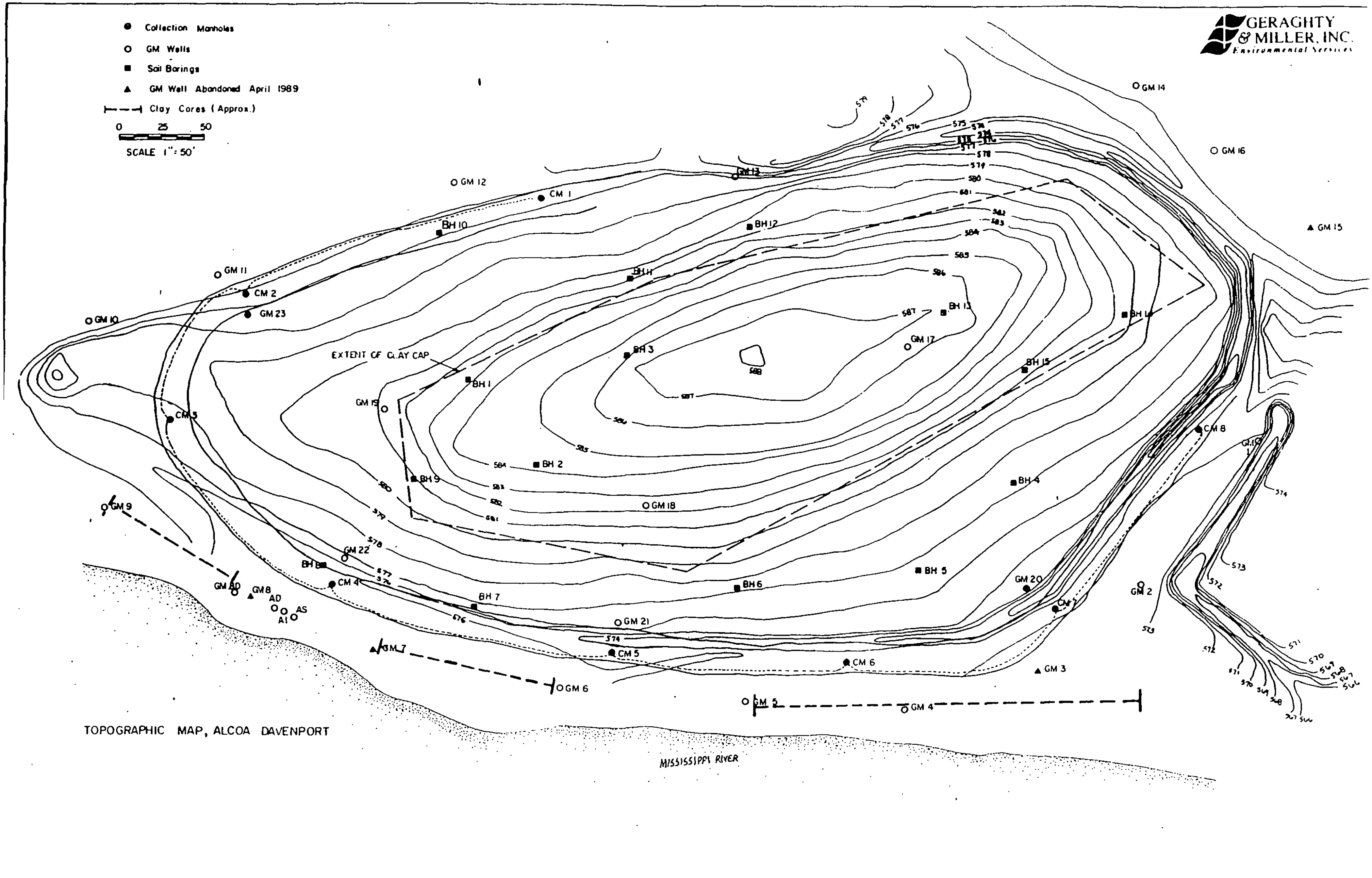
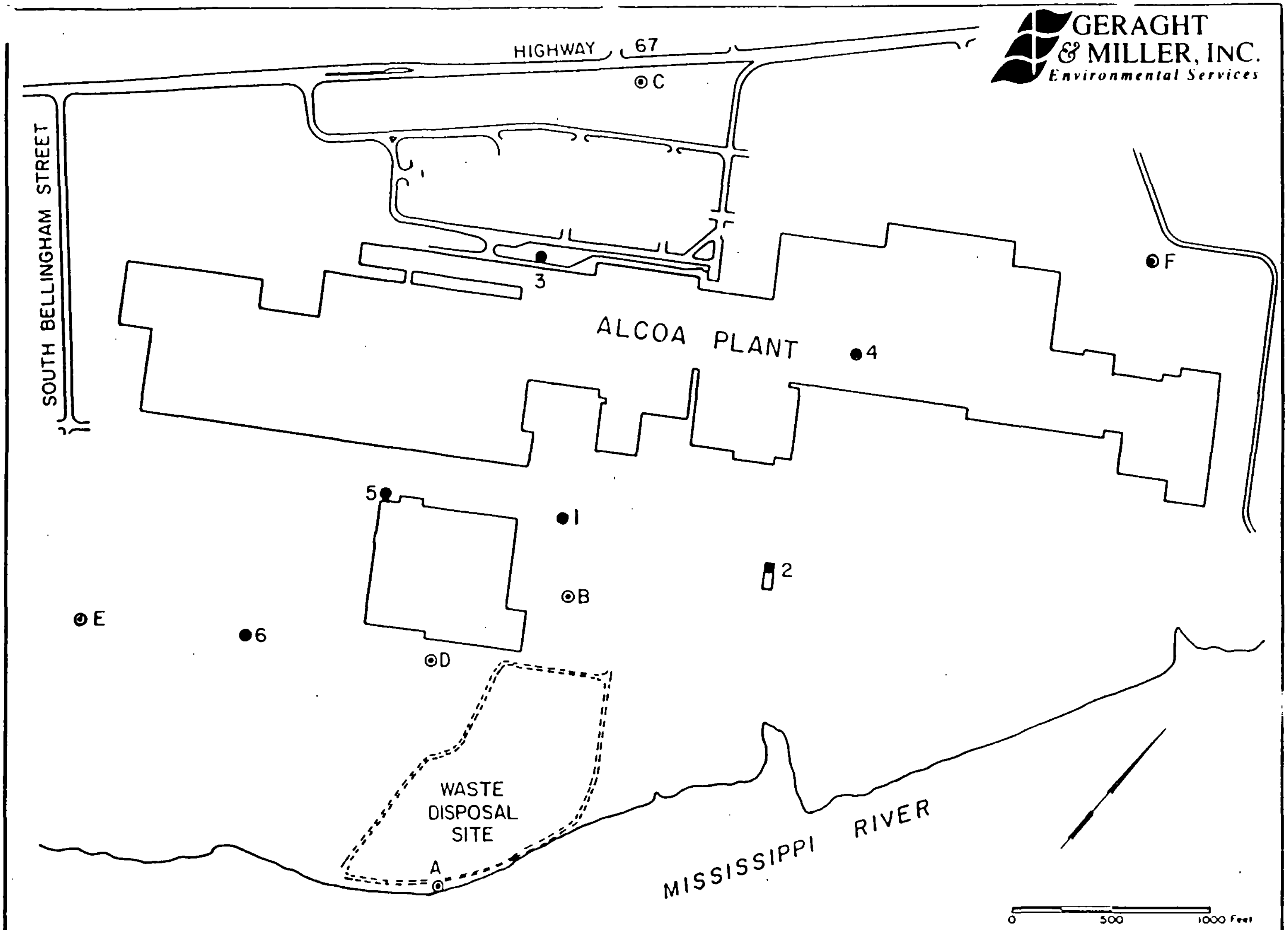


Figure 2. Topographic Map of the Waste Site Illustrating the Areal Extent of the Clay Cap, Clay Cores, and the Oil-Interception Trench. The Locations of the Collection Wells, Monitor Wells, and Subsurface Borings are Included on the Map.

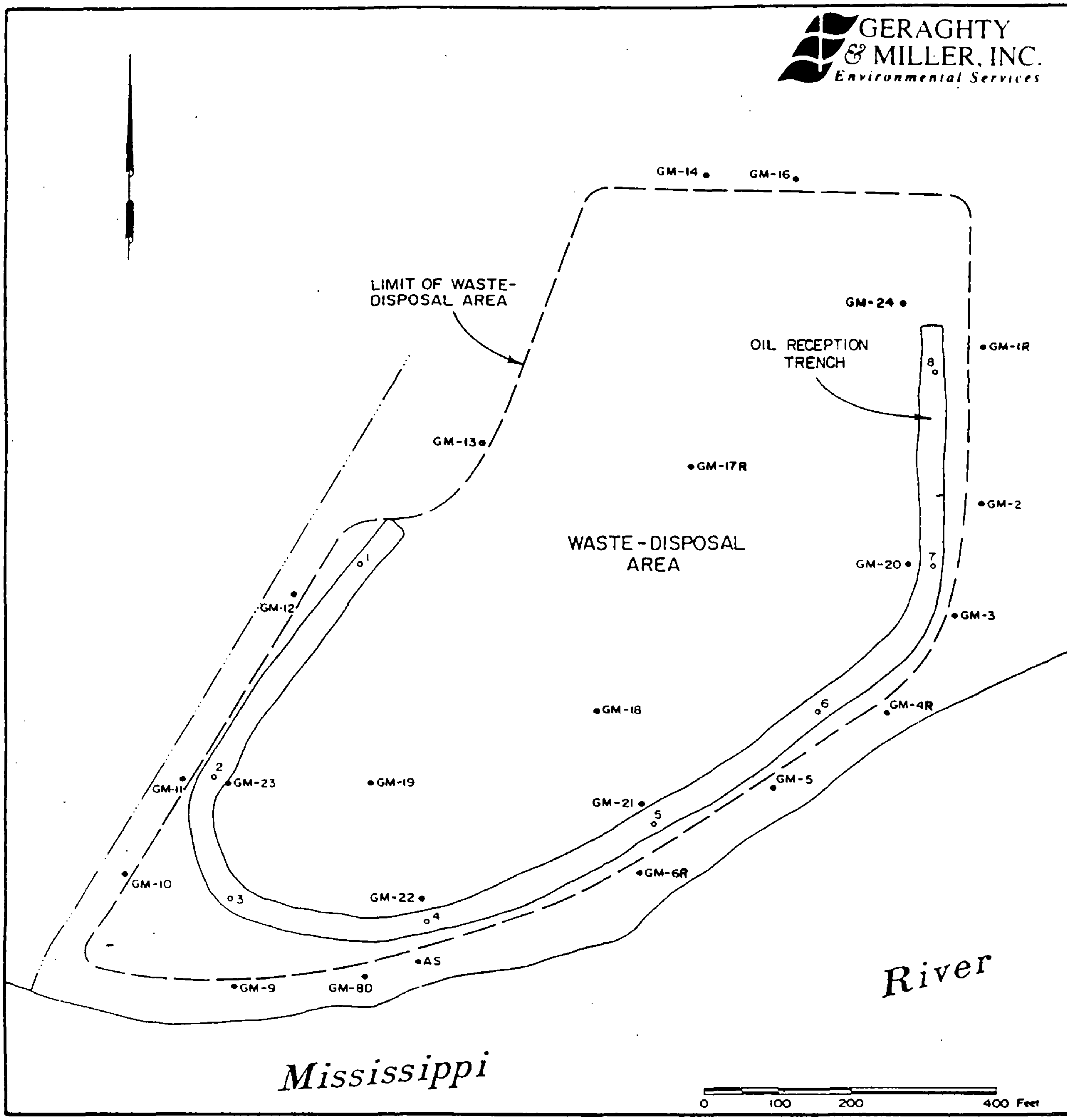


EXPLANATION

● ALCOA PROCESS-WATER WELL

◉ BEDROCK MONITOR WELL CLUSTER

Figure 3. Location of Existing Bedrock Monitor Well Clusters and Plant Process-Water Wells at the Alcoa-Davenport Plant.



EXPLANATION

- GM-16 Monitor Well
- 8 Collection Well
- GM-17R Replacement Well, Installed April, 1989

Figure 4. Configuration of Existing Collection Wells and Monitor Wells at the Alcoa Waste Site.

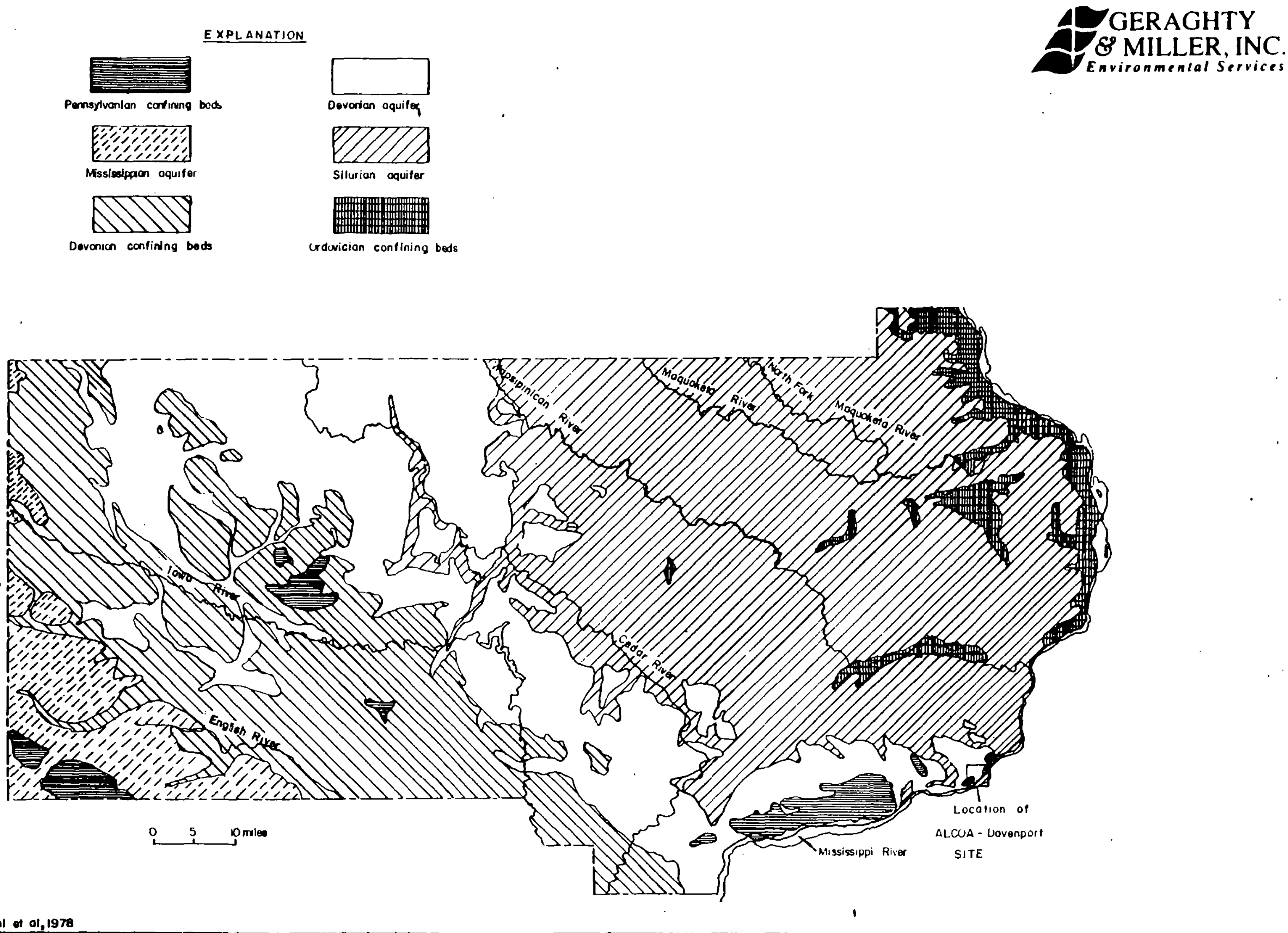


Figure 5. Hydrogeologic Map Indicating the Bedrock Aquifers and Confining Beds that Comprise the Bedrock Surface in East-Central Iowa.

Hydrologic Unit	General thickness in feet	Age of rocks	Name of rock units	Type of rock
* Surficial aquifers alluvial buried-channel drift	0 to 400	Quaternary (0 to 1 million years old)	Quaternary deposits undifferentiated	Sand, gravel, silt and clay Sand, gravel, silt and clay Till (sandy, pebbly clay) sand, silt
* Pennsylvanian rocks principaplly confining beds; locally contains waterbearing sandstone	0 to 70	Pennsylvanian (280 to 310 million years old)	Pennsylvanian rocks, undifferentiated	Shale, sandstone, limestone, and coal
Mississippiran aquifer	0 to 220	Mississippian (310 to 345 million years old)	Meramecian Series Osagean Series Kinerhookian Series	Limestone and sandstone Dolomite, limestone, and shale Limestone, dolomite, and siltstone
Devonian confining beds	0 to 350	Devonian (345 to 400 million years old)	Yellow Spring Group Lime Creek Shale	Shale, dolomite and siltstone Dolomite and shale
* Devonian aquifer	0 to 400		Cedar CreekValley Limestone Wapsipinicon Limestone	Limestone and domolite Dolomite, limestone and shale
* Silurian aquifer	0 to 450	Silurian (400 to 425 million years old)	Gower Dolomite Hopkinton Dolomite Kankakee Limestone Edgewood Dolomite	Dolomite with some chert and limestone
* Ordovician confining beds	300 to 600	Ordovician (425 to 500 million years old)	Maquoketa Shale Galena Dolomite Decorah Formation Platteville Formation	Dolomite and shale Dolomite and chert Limestone and shale Limestone and shale
Cambrian-Ordovician aquifer	400 to 650		St. Peter Sandstone Prairie du Chien Formation Jordan Sandstone St. Lawrence Dolomite	Sandstone Dolomite, sandstone, and shale Sandstone Dolomite
Cambrian confining beds	90 to 290	Cambrian (500 to 600 million years old)	Franconia Sandstone	Shale, siltstone, and sandstone
Dresbach aquifer	157 to 1644		Dresbach Group Galesvills Sandstone Eau Claire Sandstone Mt. Simon Sandstone	Sandstone Sandstone, shale, and dolomite Sandstone
Precambrian rocks		Precambrian (600 to more than 2 billion years old)	Crystalline rocks, undifferentiated	Sandstone, igneous and metamorphic rocks

From Wahl et al, 1978

NOTES:
- = Highlighted Units Represent Aquifers
* = Indicates Units Identified Beneath Alcoa-Davenport Plant

FIGURE 6. Hydrogeologic Units in East-Central Iowa.

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FIGURE 7

STRATIGRAPHIC COLUMN OF GEOLOGIC UNITS
WITHIN SCOTT COUNTY

	GROUP	SYSTEM	SERIES	STAGE	SUB-STAGE
I	Cenozoic	Pleistocene	Recent	Alluvial	
			Glacial	Iowan Sangamon Illinoian Yarmouth Kansan Aftonian Pre-Kansan	
				Residual Clays Geest	
II	Paleozoic	Carboniferous	Upper Carboniferous	Des Moines	
		Devonian	Middle Devonian	Cedar valley	Dielasma beds Spirifer Parryanus beds
				Wapsipinicon	Upper Davenport Lower Davenport Independence Otis
	*	Silurian	Niagara	Gower	Anamosa Le Claire

After Norton, 1898

I Unconsolidated Sedimentary Horizons
II Consolidated Sedimentary Rock Units

* Denotes the Tippecanoe-Kaskaskia Unconformity (Anderson et al, 1982)

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SYSTEM	SERIES AND MEGAGROUP	GROUP AND FORMATION	HYDROSTRATIGRAPHIC UNITS Aquigroup	HYDROSTRATIGRAPHIC UNITS aquifer/aquitard	LOG	THICKNESS (ft)	DESCRIPTION	DRILLING AND CASING CONDITIONS	WATER-YIELDING PROPERTIES	CHEMICAL QUALITY OF WATER	WATER TEMPERATURE °F
Quaternary	Pleistocene	Undifferentiated	*Prairie*	Pleistocene		0 – 600	Unconsolidated glacial deposits - pebbly clay (till) silt, and gravel. Loess (windblown silt), and alluvial silts, sands and gravels.	Boulders, heaving sand locally; sand and gravel wells usually require screens and development; casing in wells into bedrock.	Sand and gravel, permeable. Locally, wells yield as much as 3000 gpm. Specific capacities vary from about 0.1 to 5600 gpm/ft.	TDS generally between 400 and 600 mg/L. Hardness 300–400 mg/L. Iron generally 1–5 mg/L.	50 – 64
Tertiary & Cretaceous		Undifferentiated				0 - 100	Sand and silt.				
Carboniferous – Pennsylvanian		Undifferentiated	Upper Bedrock; Mississippi Valley	Pennsylvanian		0 – 500	Mainly shale with thin sandstone, limestone and coal beds.	Shale requires casing.	Extremely variable. Sandstone and limestone units generally yield less than 10 gpm.	TDS extremely variable regionally and with depth. North-central Illinois, 500–1500 mg/L; southern, 500–3000 mg/L. Hardness: 150–400 mg/L north; 150–1000 mg/L south. Iron generally 1–5 mg/L.	53 – 57
Carboniferous – Mississippian	Valmeyeran	St. Louis Ls Salem Ls Warsaw Ls Keokuk Ls Burlington Ls		St. Louis - Salem aquifer Keokuk – Burlington aquifer		0 – 600	Limestone, cherty limestone, green, brown and black shale, silty dolomite.		In southern two-thirds of IL., yields generally less than 25 gpm.	TDS ranges between 400 and 1000 mg/L. *Hardness is generally between 200 and 400 mg/L.* Iron: 0.3–1.0 mg/L.	53 – 59
Carboniferous – Mississippian	Kinderhookian	Undifferentiated									
Devonian		Undifferentiated		Devonian		0 – 400	Shale, calcareous; limestone beds, thin.				
Silurian	Niagaran	Port Byron Fm Racine Fm Waukesha Ls Joliet Ls		Silurian dolomite aquifer		0 – 465	Dolomite, silty at base, locally cherty.	Upper part usually weathered and broken; crevicing varies widely.	Yields inconsistent. Major aquifer in NE and NW Illinois. Yields in fractured zones more than 1000 gpm.	TDS: 350–1000 mg/L; Hardness: 200–400 mg/L; Iron: 0.3–1.0 mg/L.	52 – 54
Silurian	Alexandrian	Kankakee Ls Edgewood Ls									
Ordovician	Cincinnatian	Maquoketa Shale Group	Midwest Bedrock	Maquoketa confining unit		0 – 250	Shale, gray or brown; locally dolomite and/or limestone, argillaceous.	Shale requires casing.	Shales generally not water yielding. Crevices in dolomite units yield small local supplies.		
Ordovician	Mohawkian (Ottawa Ls Megagroup)	Galena Group Decorah Subgroup Platteville Group		Galena–Platteville unit		0 – 450	Dolomite and/or limestone, cherty. Dolomite, shale partings, speckled. Dolomite and/or limestone, cherty, sandy at base.	*Crevicing commonly where formations underlie drift.* Top of Galena usually selected for hole reduction and seating of casing.	*Where overlain by shales, crevicing and well yields small.* Where overlain by drift wells yield moderate quantities of water.	For Midwest Bedrock Aquigroup as a whole, TDS *ranges from 400 to 1400 mg/L in NW and up to* 2000 mg/L in south. Hardness ranges from 175 mg/L in northern recharge areas to 600 mg/L in E. Cook and S. Fulton Counties. Iron generally less than 1.0 mg/L.	52 – 73
Ordovician	Chazyan (Ancell Gr)	Glenwood Fm St. Peter Ss		Ancell aquifer		100 – 650	Sandstone, fine- and coarse-grained; little dolomite; shale at top. Sandstone, fine- to medium-grained; locally cherty red shale at base.	Lower cherty shales cave and are usually cased. *Friable sand may slough.*	Small to moderate quantities of water. Transmissivity approximately 15 percent of that of the Midwest Bedrock Aquigroup.		
Ordovician	Canadian (Knox Megagroup; Prairie du Chien Group)	Shakopee Dol New Richmond Ss Oneota Dol *Gunter Ss*		Middle confining unit: Prairie du Chien		100 – 1300	Dolomite, sandy, cherty (oolitic), sandstone. *Sandstone, interbedded with dolomite.* Dolomite, white to pink, coarse-grained, cherty (oolitic), sandy at base.	Crevices encountered locally in the dolomite, especially in the Eminence–Potosi. Casing not required.	Crevices in dolomite and sandstone yield small to *moderate quantities of water. Transmissivity* approximately 35 percent of that of the Midwest Bedrock Aquigroup.		
Cambrian	St. Croixian (Knox Megagroup)	Jordan Ss Eminence Fm–Potosi Dolomite		Middle confining unit: Eminence-Potosi			Dolomite, white, fine-grained, geodic quartz, sandy at base.				
Cambrian	St. Croixian (Knox Megagroup)	Franconia Fm		Middle confining unit: Franconia			Dolomite, sandstone, and shale, glauconitic, green to red, micaceous.				
Cambrian	St. Croixian	Ironton Ss Galesville Ss		Ironton–Galesville aquifer		0 – 270	*Sandstone, fine- to medium-grained,* well sorted, upper part dolomitic.	Amount of cementation variable. Lower part more friable. Sometimes sloughs.	Most productive unit of the Midwest Bedrock Aquigroup. Yields over 500 gpm common in northern Illinois. Transmissivity approximately 50 percent of that of the Midwest Bedrock Aquigroup.		
Cambrian	St. Croixian	Eau Claire Fm	Basal Bedrock	Eau Claire		0 – 450	Shale and siltstone; dolomite, glauconitic; sandstone, dolomitic, glauconitic.	Casing not usually necessary. Locally weak shales may require casing.	Shales generally not water yielding.		
Cambrian	St. Croixian	Mt. Simon Fm		Elmhurst-Mt. Simon aquifer		0 – 2600	Sandstone, coarse-grained, white, red in lower half; lenses of shale and siltstone, red, micaceous.	Casing not required.	Moderate quantities of water in upper units. Comparable in permeability to the Glenwood–St. Peter Sandstone.	Varies northwest to southeast and with depth. At shallower depths, TDS: 235–4000 mg/L. Hardness: 220–800 mg/L, Iron: 0.1–20 mg/L. High chloride concentrations with depth.	51 – 62 in the north 80 or more in the south
Pre-Cambrian			Crystalline				No aquifers in Illinois				

Note: The rock-stratigraphic and hydrostratigraphic-unit classifications follow the usage of the Illinois State Geological Survey. Compiled by Visocky, Sherrill, & Cartwright 1985

Figure 8. Regional Stratigraphy and Water-Bearing Properties of the Units.

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SYSTEM	SERIES	GROUPS	FORMATIONS	MEMBERS	GRAPHIC LOG	THICKNESS (FT)	DESCRIPTION
Quaternary	Pleistocene					0-20	Unconsolidated glacial deposits; loess glacial till, silt/clay, sand and gravel
Pennsylvanian	Des Moines	Cherokee				0-15	Dark gray-green carbonaceous shale
Devonian	Middle	Hunton Mega Group	Wapsipinicon	Kenwood		5-15	Thin bedded limestone, dolomite and shale, chert, brown in color, evaporites
				ottis		15-30	Very fine grained, light gray to buff, crystaline limestone, trace dolomite units
Silurian	Niagaran		Gower	LeClaire		225-260	White to gray, crystaline dolomite, abundant cavities, poorly bedded, contains fossifereous mound structures
				Anamosa			Light buff, grainular dolomite, evenly bedded
			Hopkinton				Light gray to pale yellow gray, fine-medium dolomite, porous, vuggy in places
	Alexandrian		Kankakee			80-90	White to tan, crystaline dolomite with chert, shale occuring locally
			Edgewood			7-10	Light gray, cherty dolomite, argillaceous
Ordovician	Cincinnatian	Maquoketa Shale Group	Brainard Shale			75-100	Silty, dolomite, weak greenish-gray shale interbedded with varying amounts of greenish-gray dolomite

Figure 9. Stratigraphic Section of the Sedimentary Formations Recorded Beneath the Alcoa-Davenport Plant.

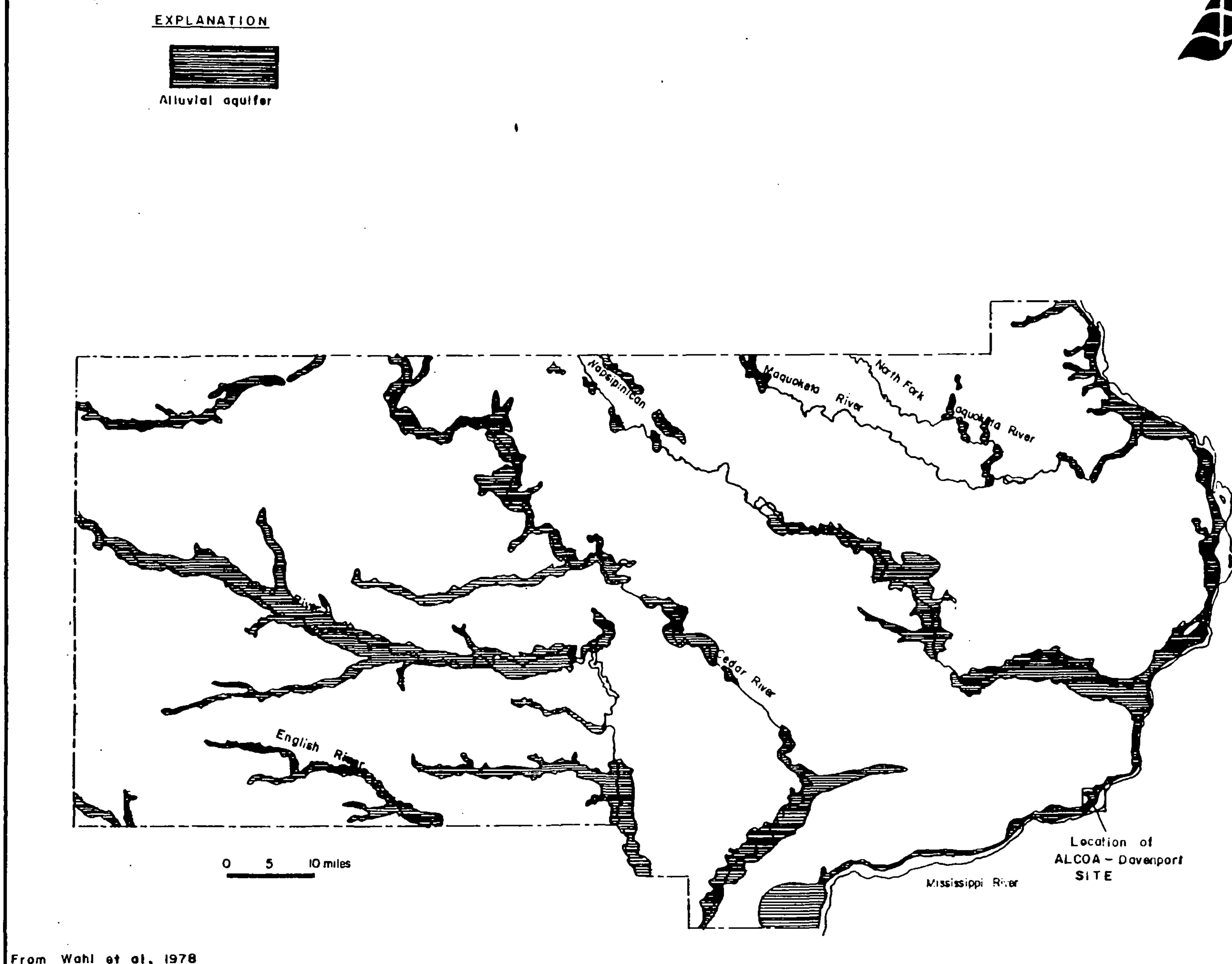

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Figure 10. Areal Extent of Alluvial Aquifers in East-Central Iowa.

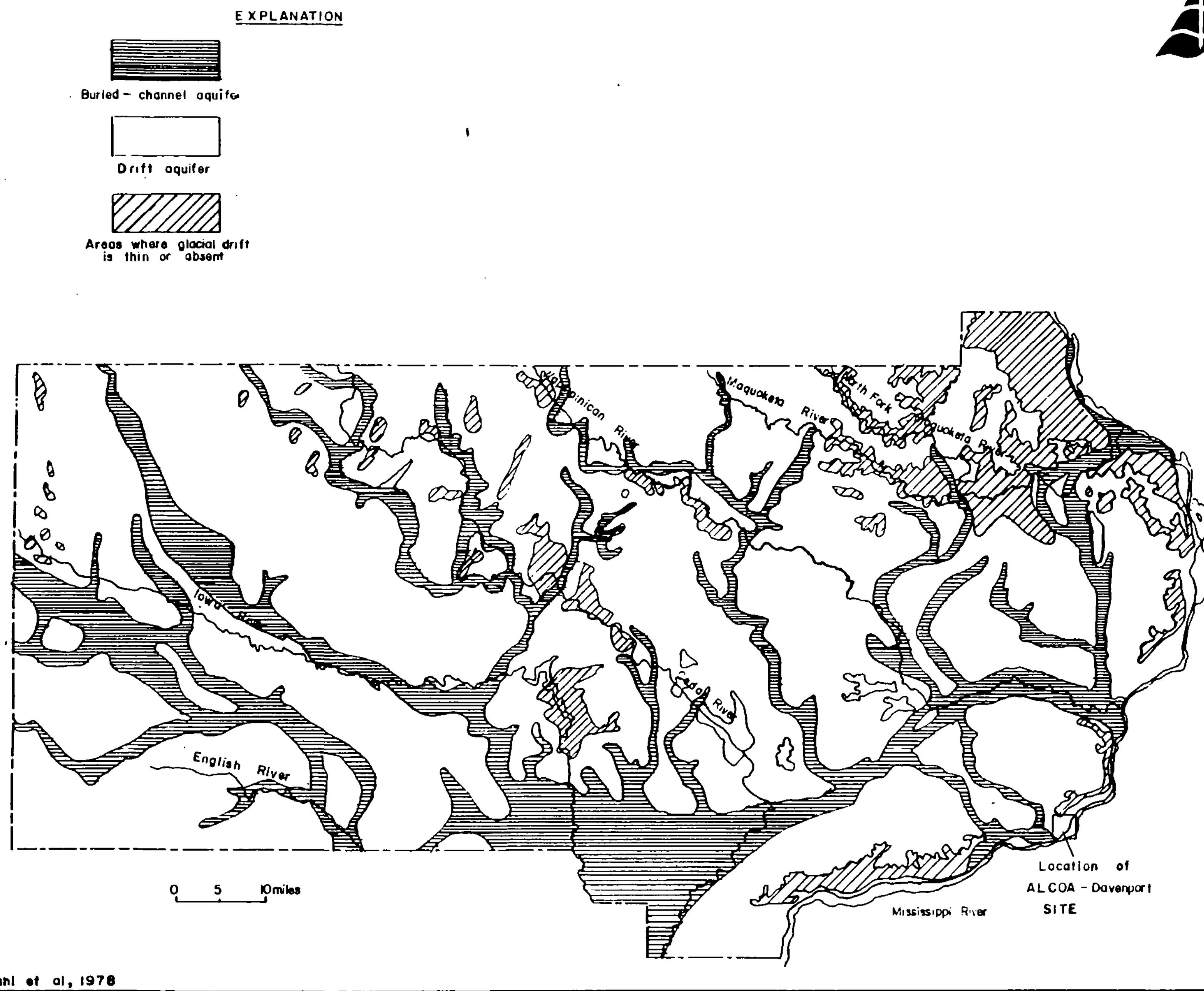

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Figure 11. Areal Extent of Drift and Buried-Channel Aquifers in East-Central Iowa.

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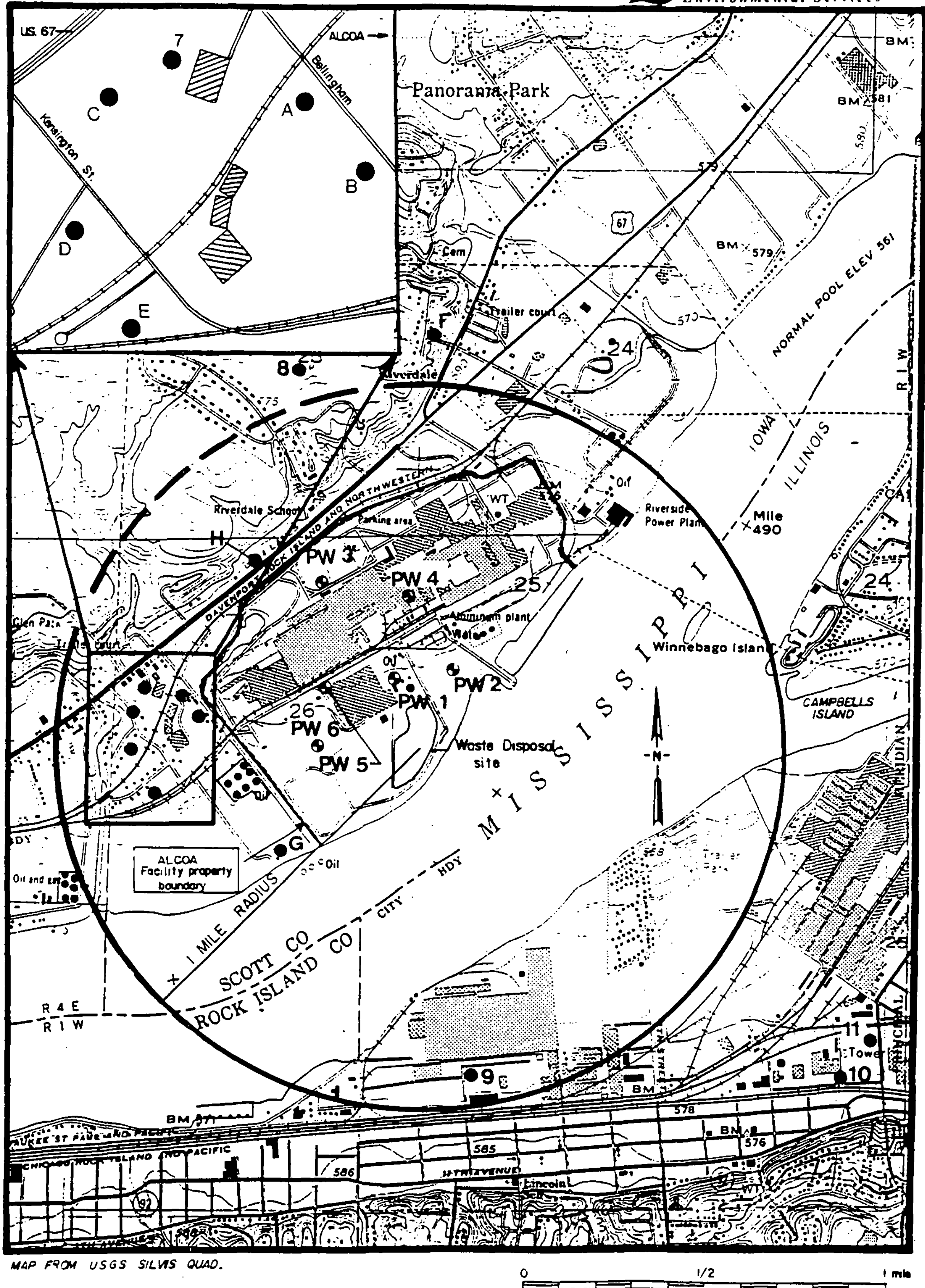


Figure 12. General Locations of Ground-Water Wells Within Approximately a One Mile Radius of the Alcoa-Davenport Waste Site.

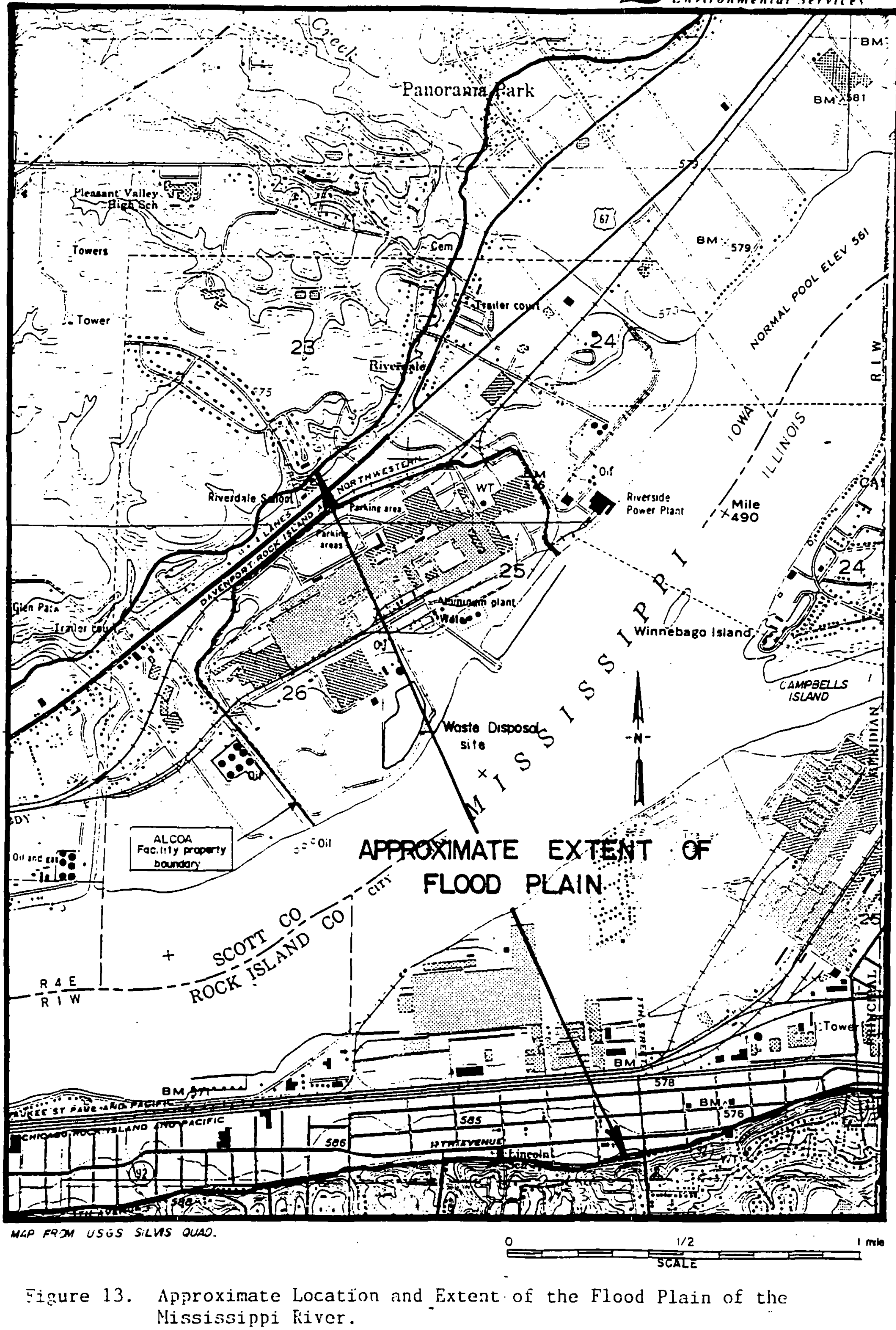


Figure 13. Approximate Location and Extent of the Flood Plain of the Mississippi River.

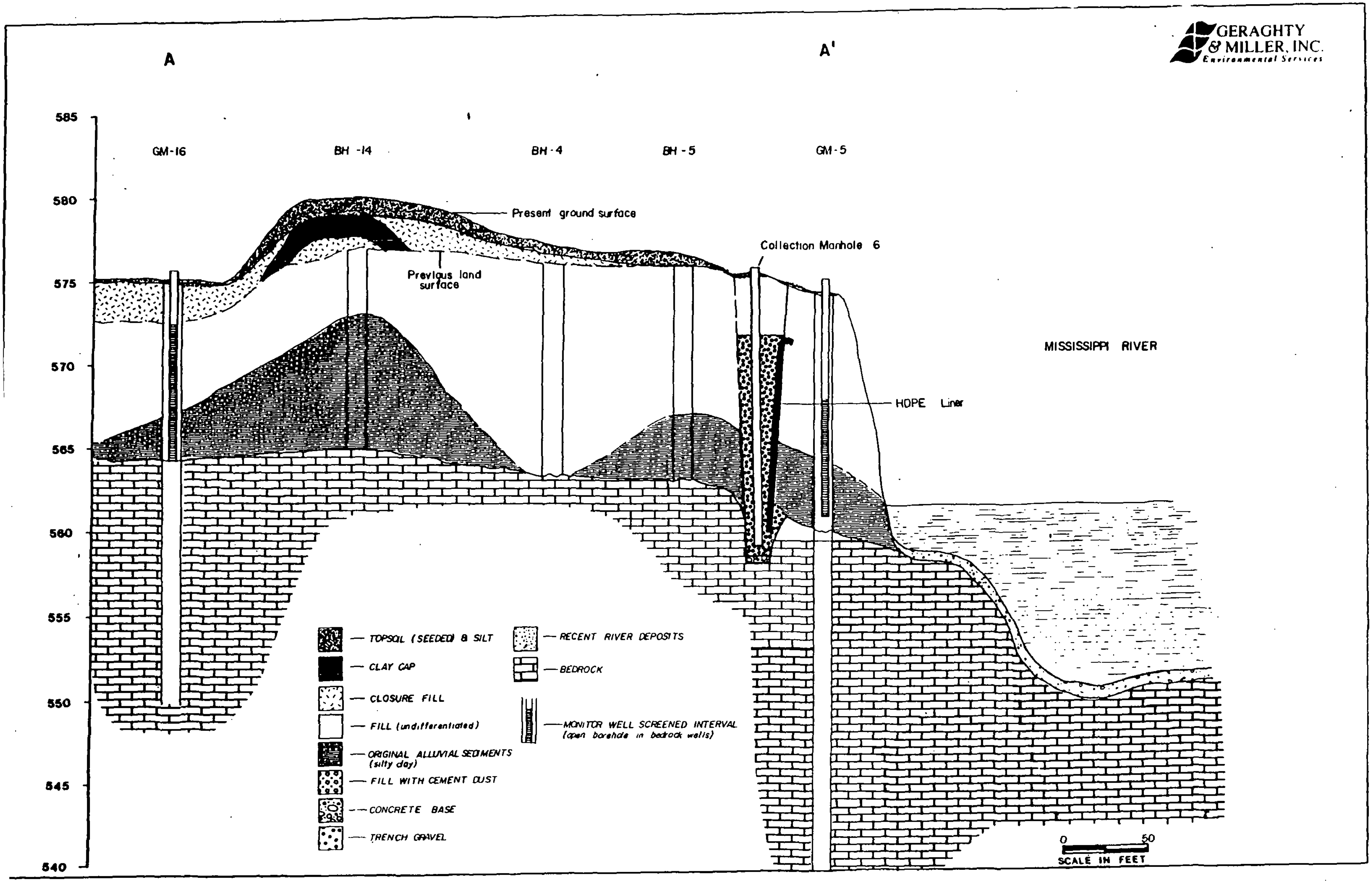


Figure 14. North-South Cross Section A-A' Along the Eastern Portion of the Alcoa-Davenport Waste Site.

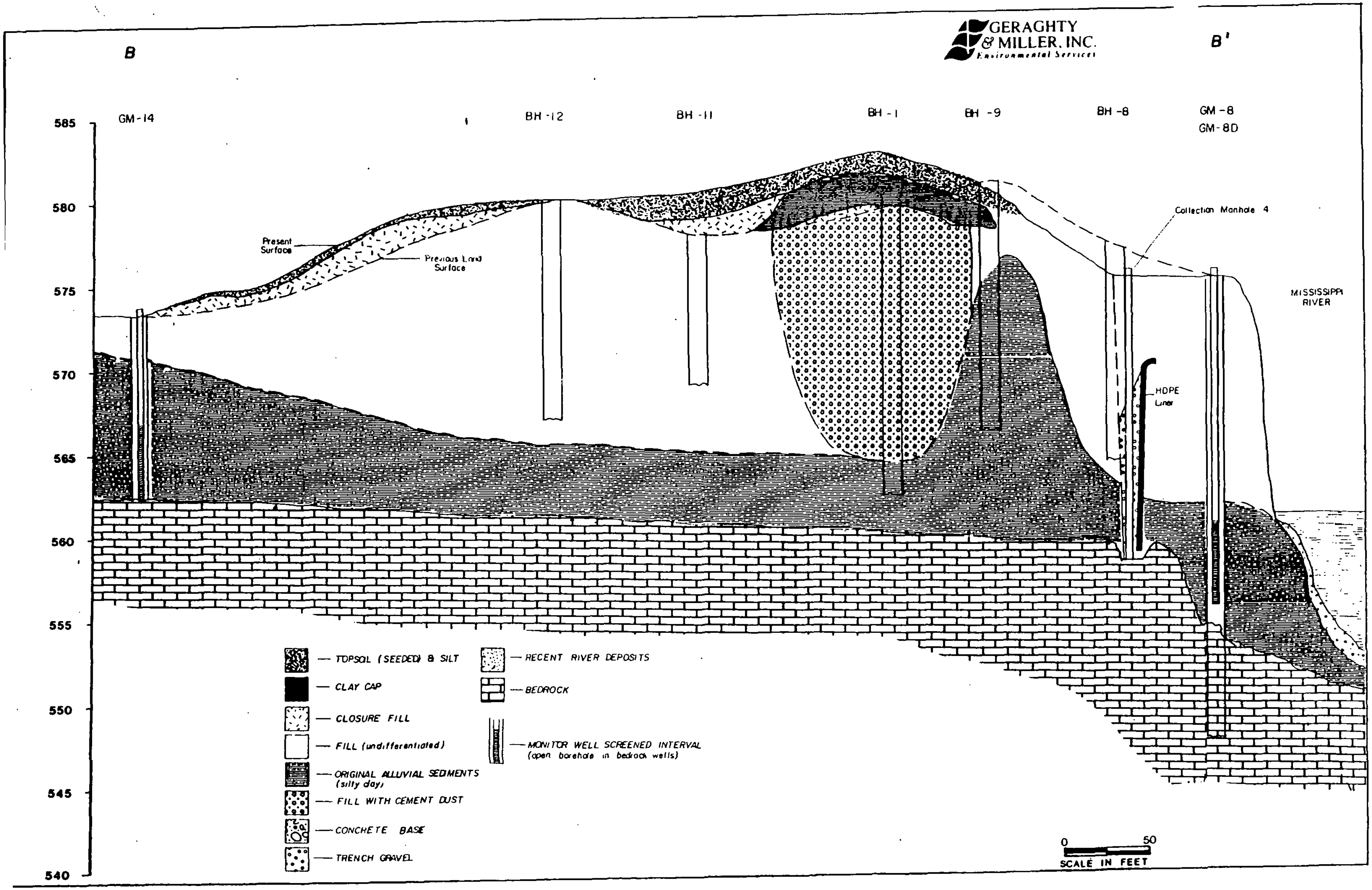


Figure 15. North-South Cross Section B-B' Along the Western Portion of the Alcoa-Davenport Waste Site.

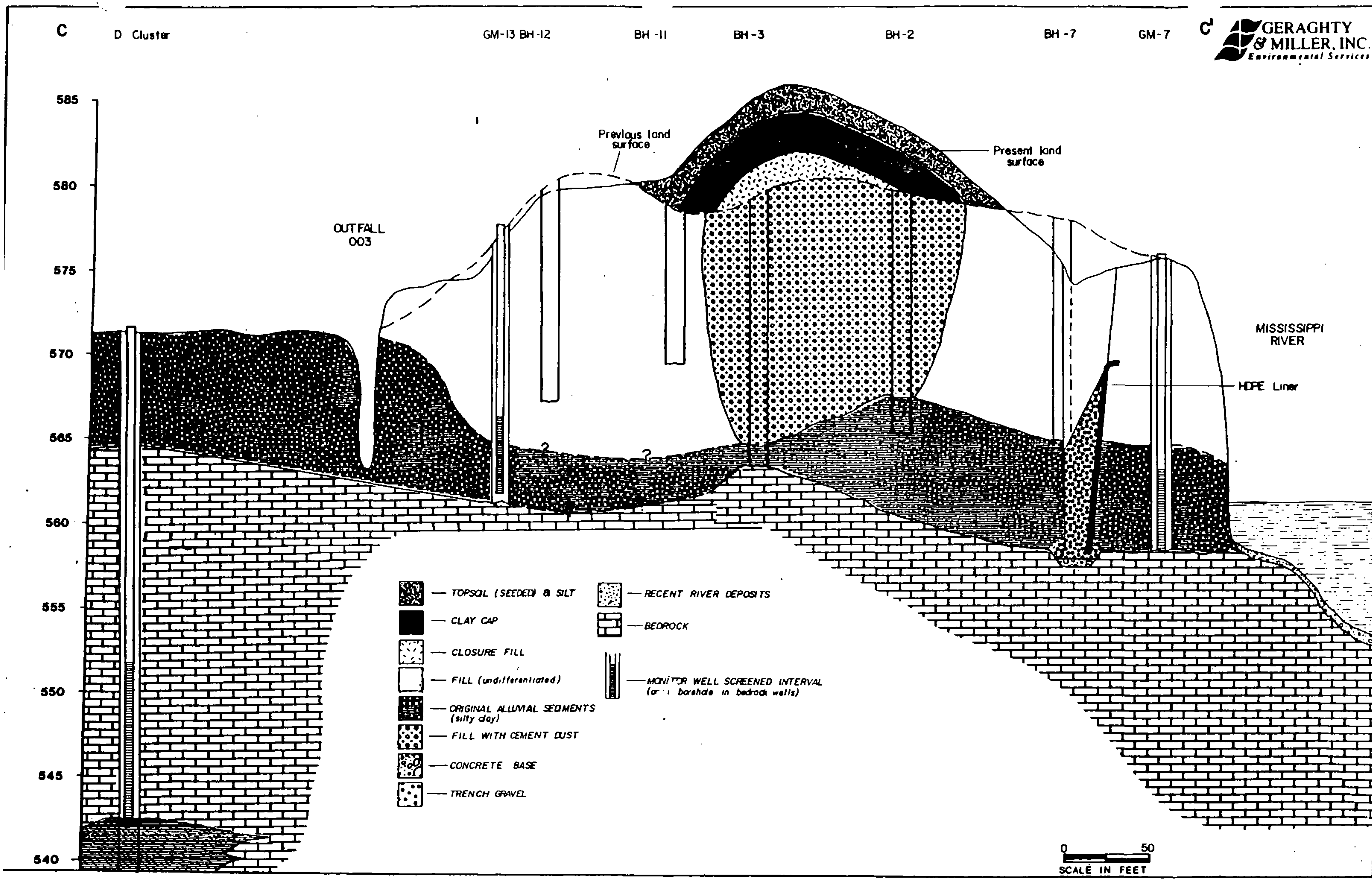


Figure 16. Northwest-Southeast Cross Section C-C' Through the Center of the Alcoa-Davenport Waste Site.

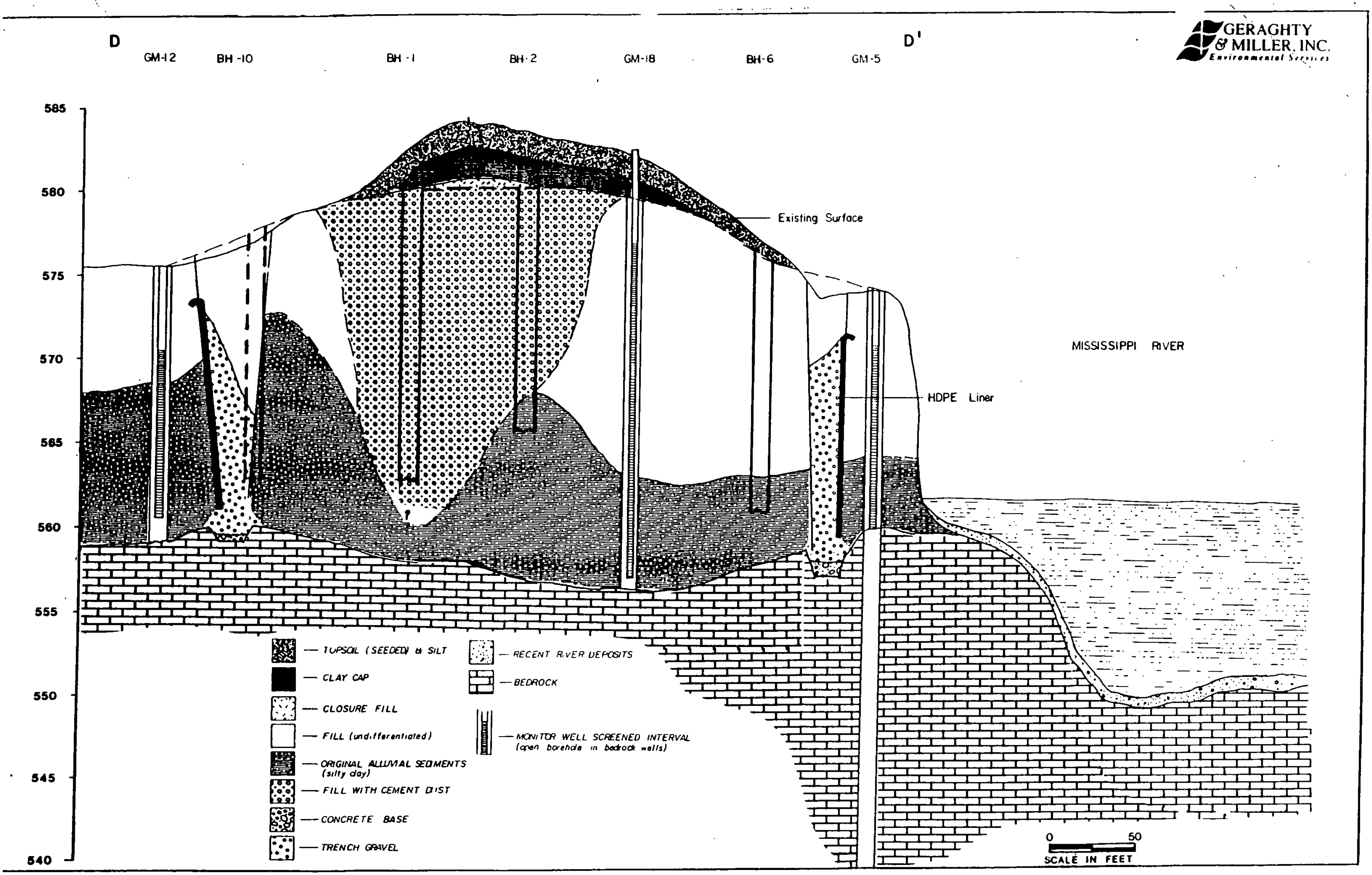


Figure 17. East-West Cross Section D-D' Along the Southern Half of the Alcoa-Davenport Waste Site.

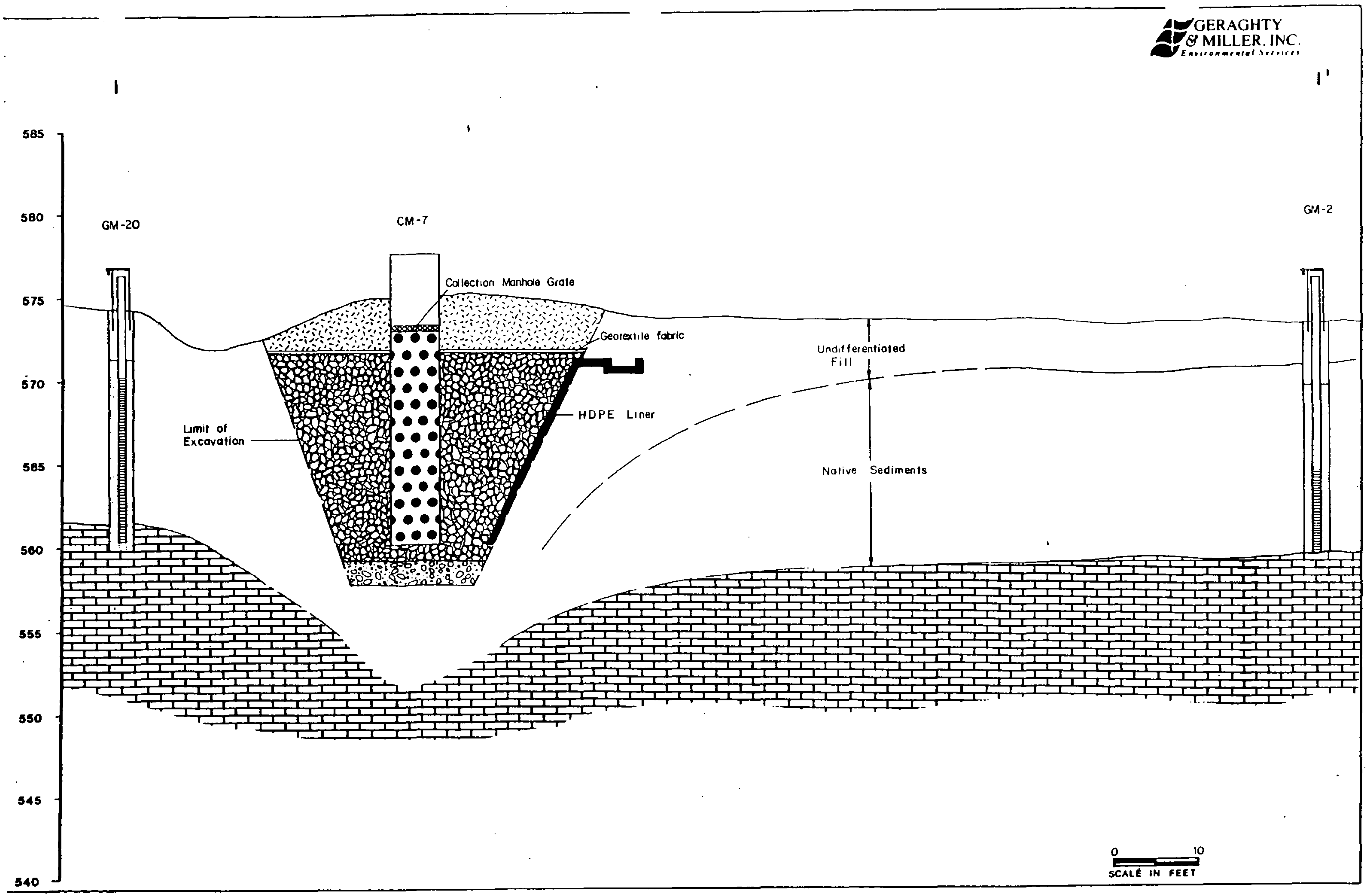


Figure 18. Cross Section I-I' of the Northeast Corner of the Oil-Interception Trench at the Alcoa-Davenport Waste Site.

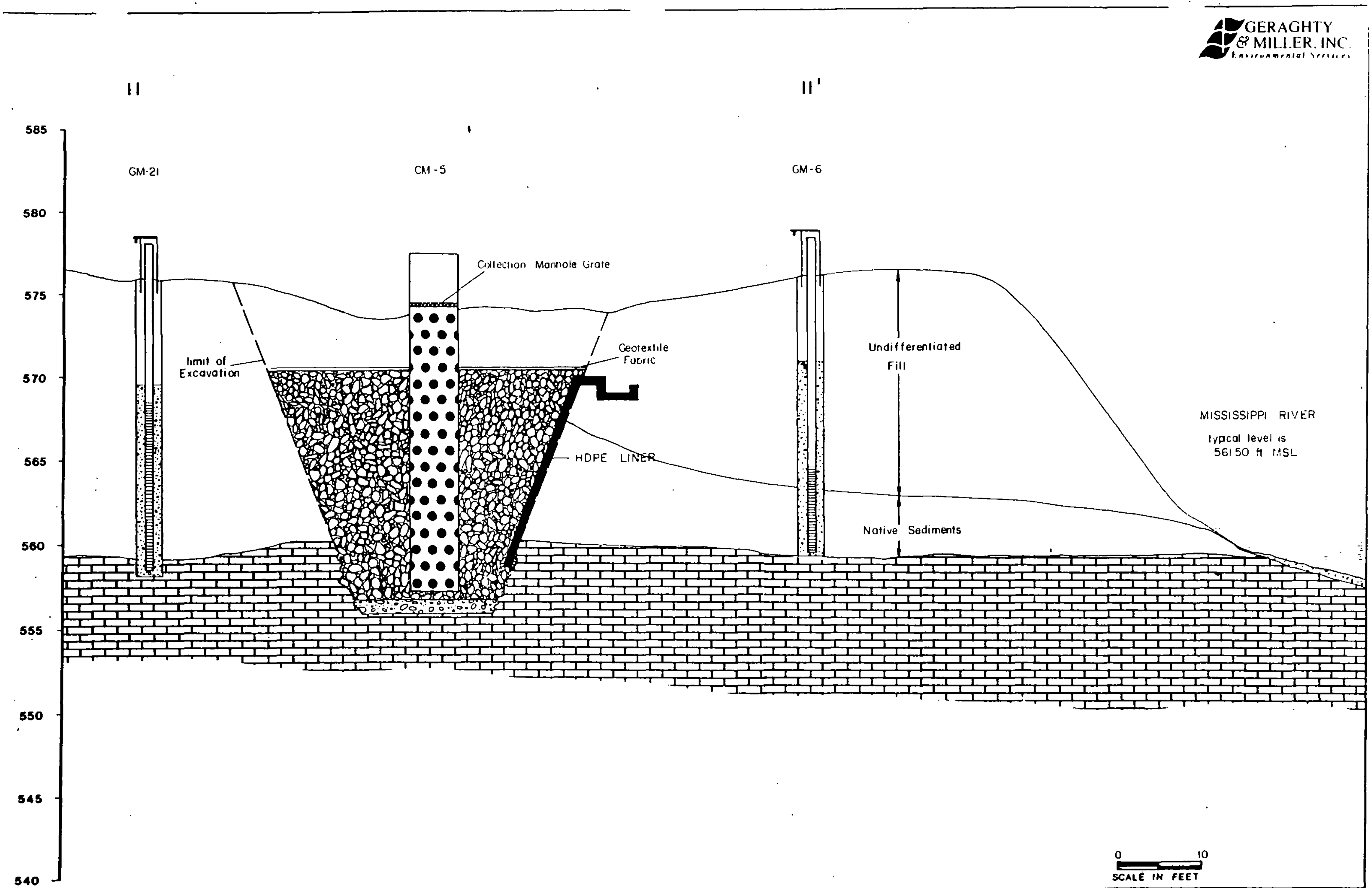


Figure 19. Cross Section II-II' of the Southeast Portion of the Oil-Interception Trench at the Alcoa-Davenport Waste Site.

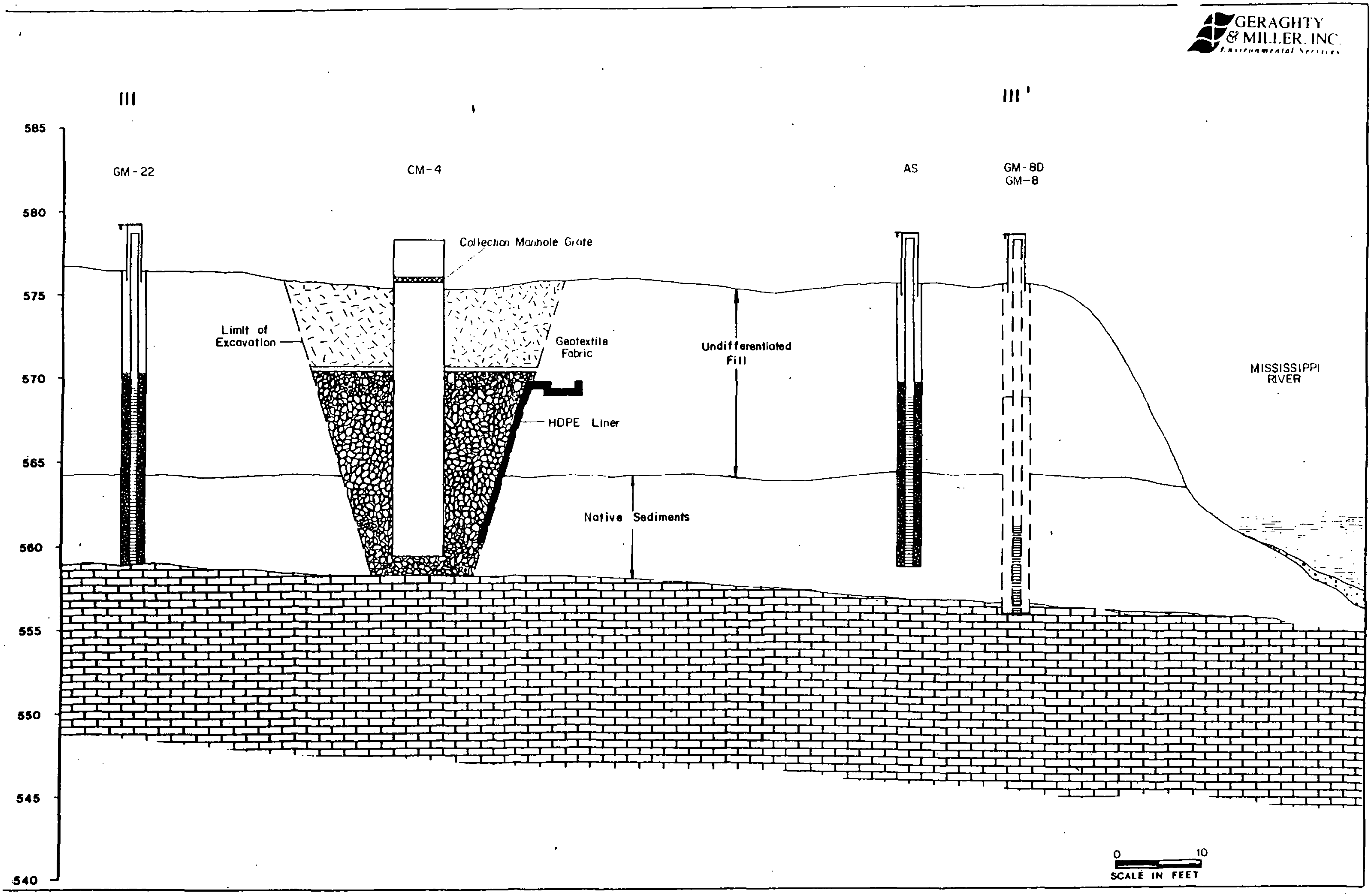


Figure 20. Cross Section III-III' of the Southern Portion of the Oil-Interception Trench at the Alcoa-Davenport Waste Site.

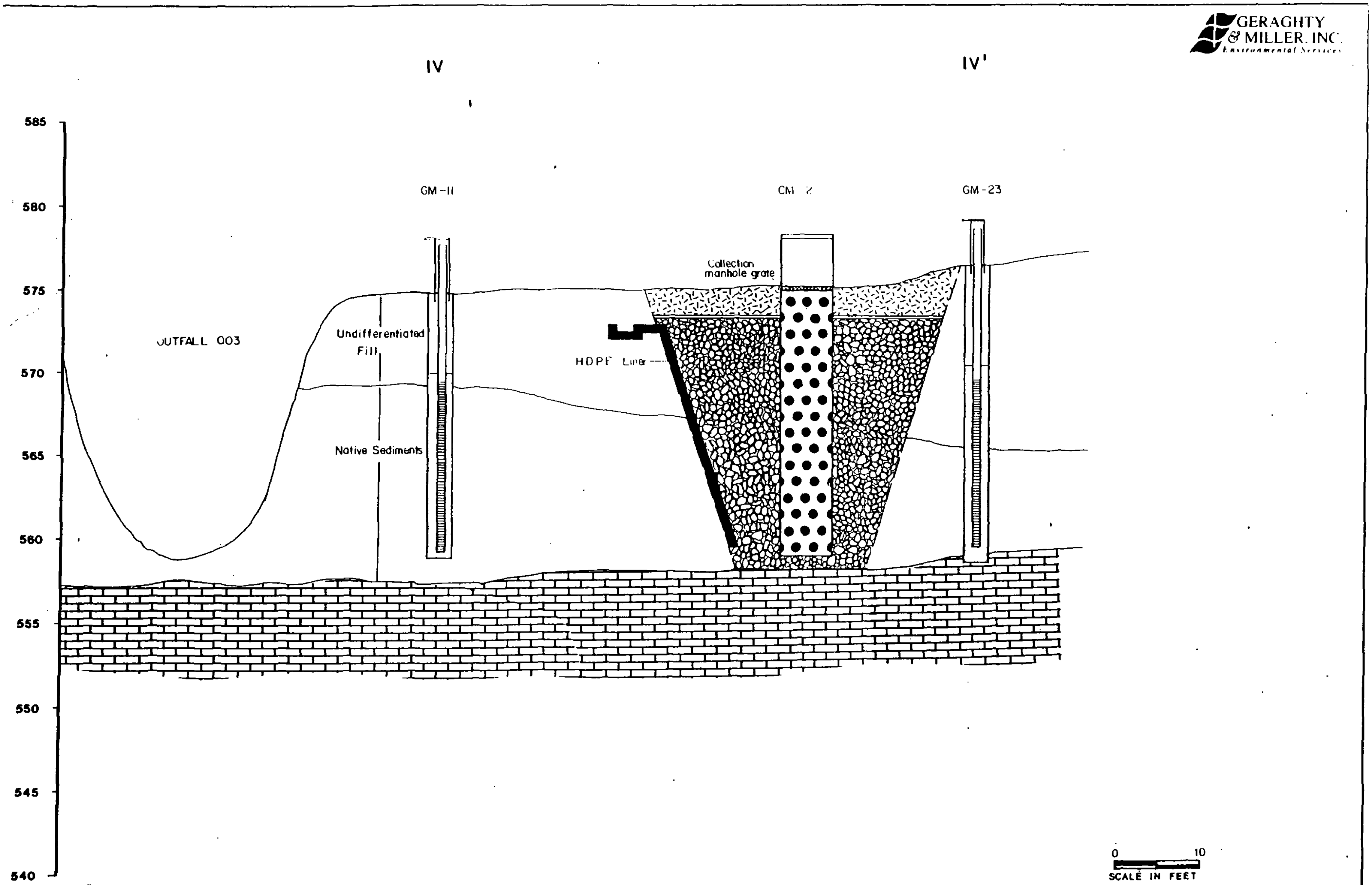


Figure 21. Cross Section IV-IV' of the Western Corner of the Oil-Interception Trench at the Alcoa-Davenport Waste Site.

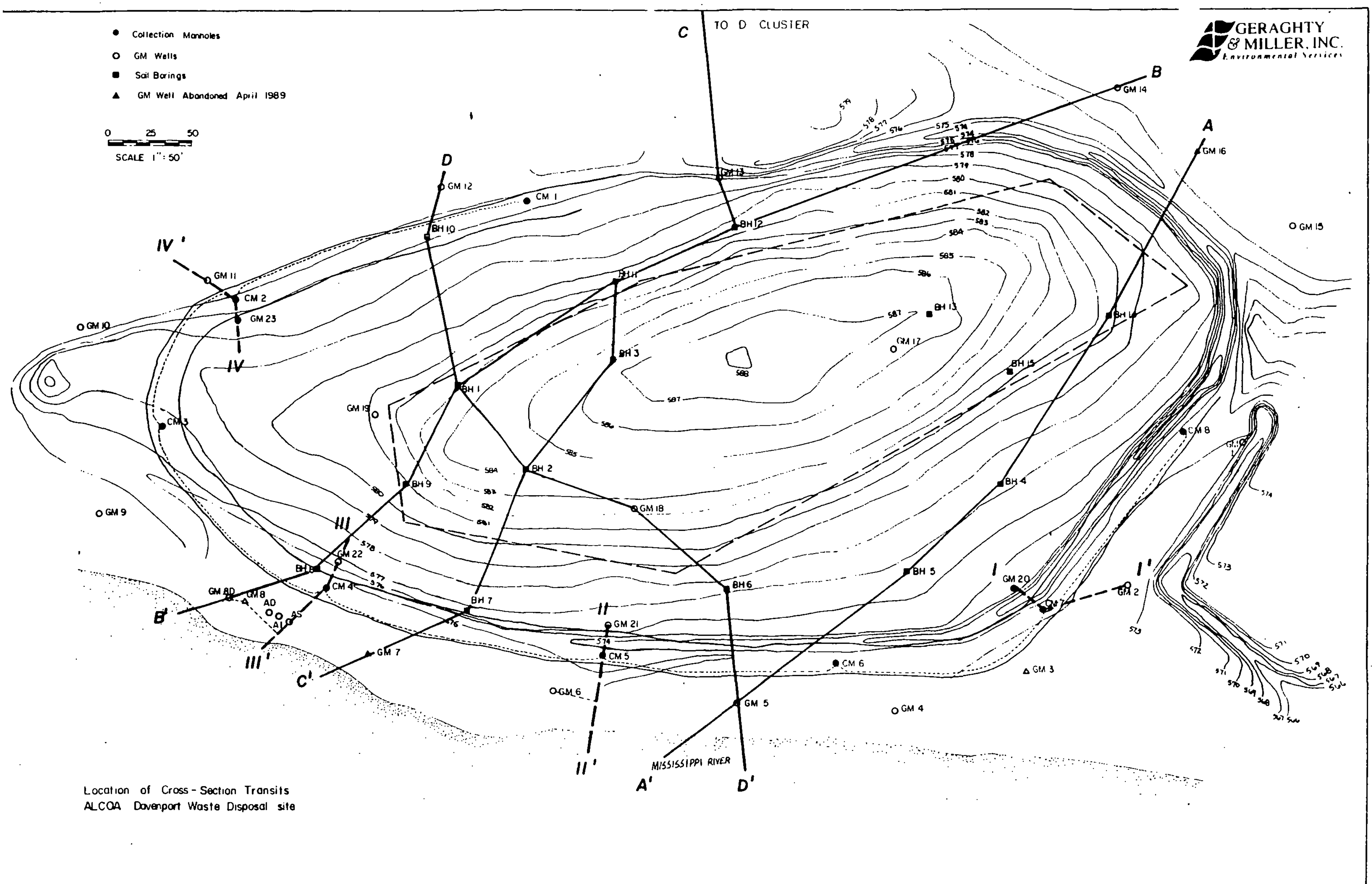
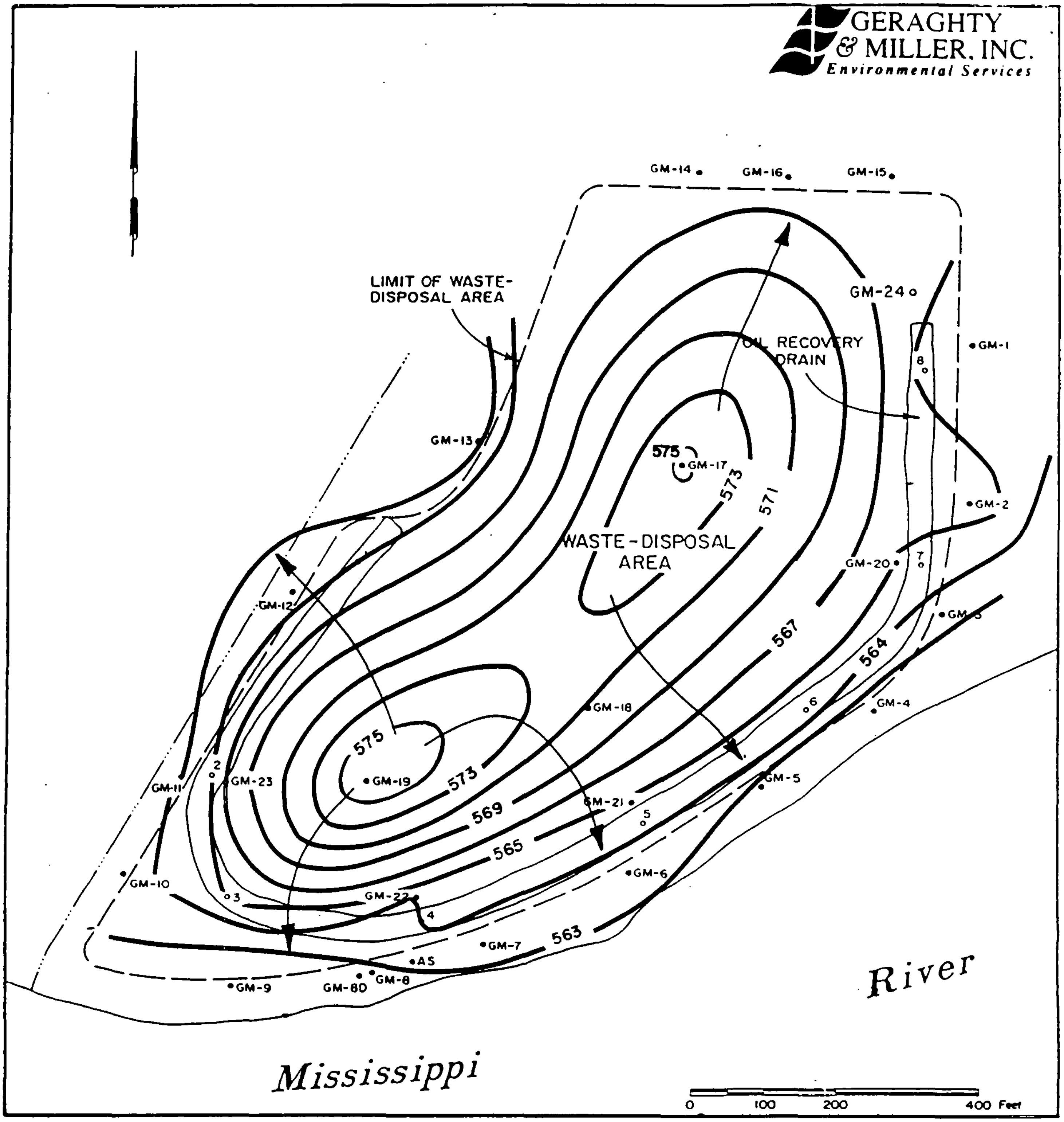


Figure 22. Map Illustrating the Locations of the Cross Section Transects.



EXPLANATION

573.87 Fluid Level Elevation, in feet MSL

Ground Water Flow Direction

—573— Ground Water Contour

Figure 23. Ground-Water Contour Map Depicting Flow Conditions at the Alcoa-Davenport Waste Site During April, 1988.

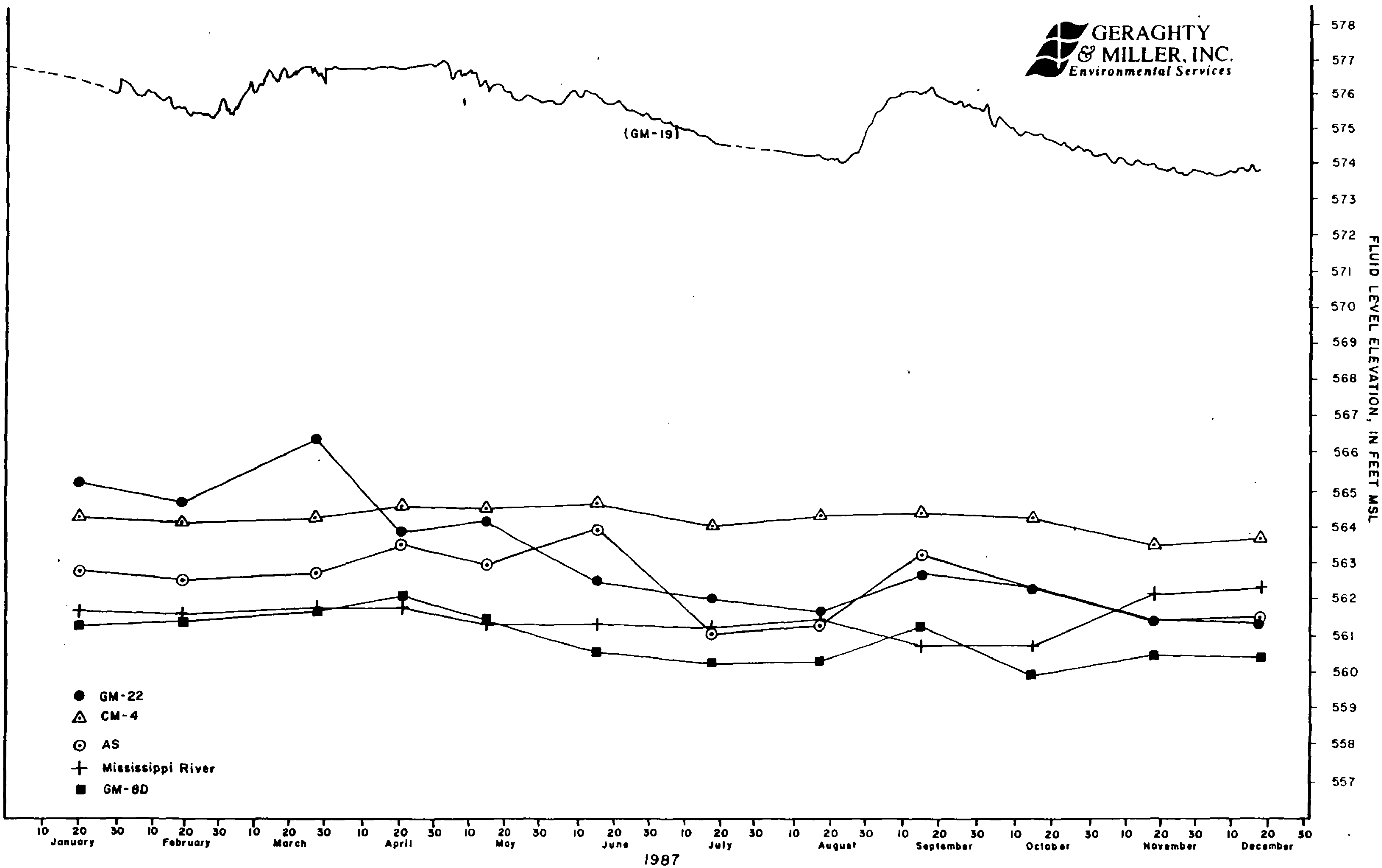


Figure 24. Hydrograph Depicting Annual Fluid-Level Fluctuations for CM-4, GM-8D, GM-22, AS and the Mississippi River for 1987.

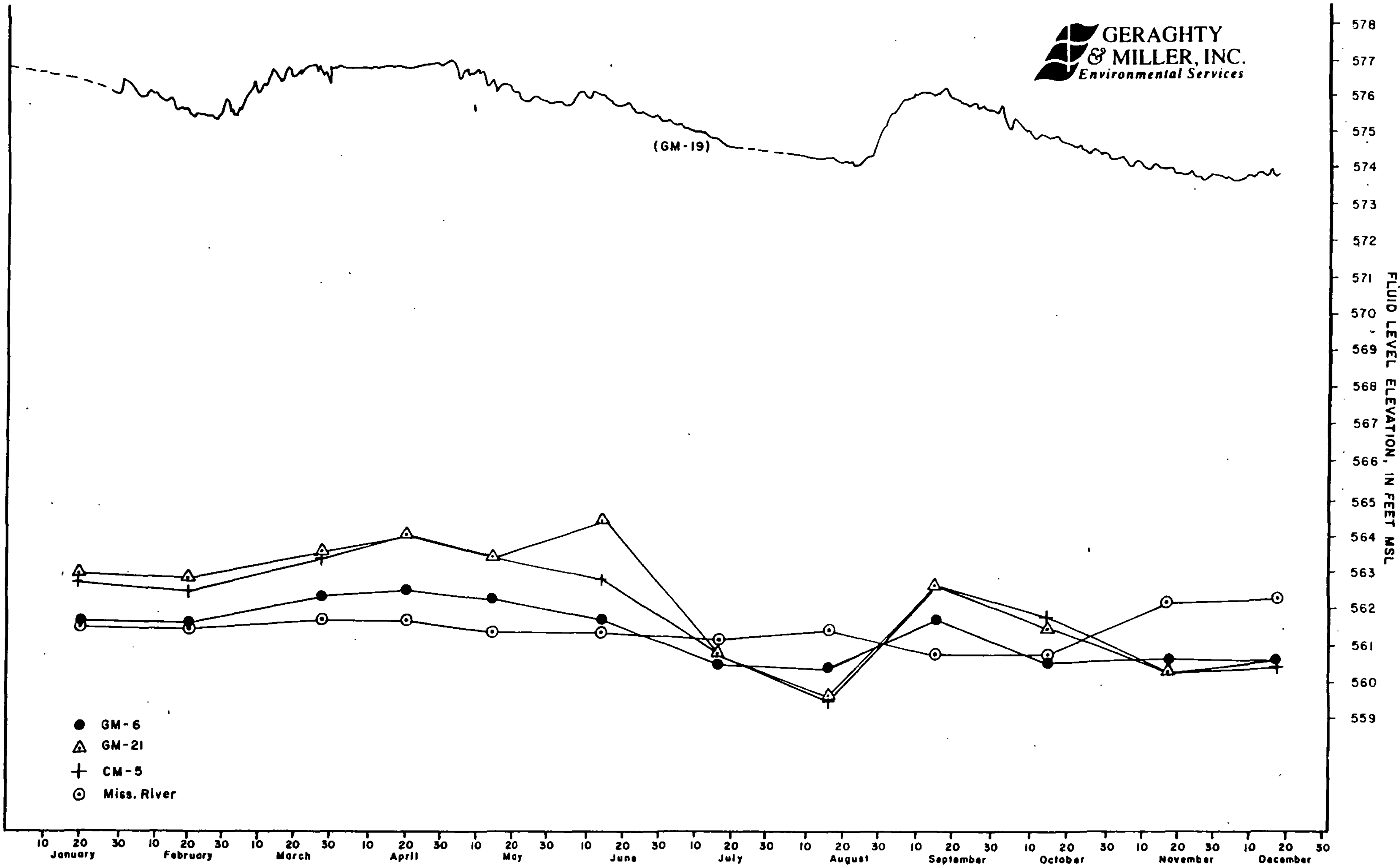


Figure 25. Hydrograph Depicting Annual Fluid-Level Fluctuations for CM-5, GM-6, GM-21 and the Mississippi River for 1987.

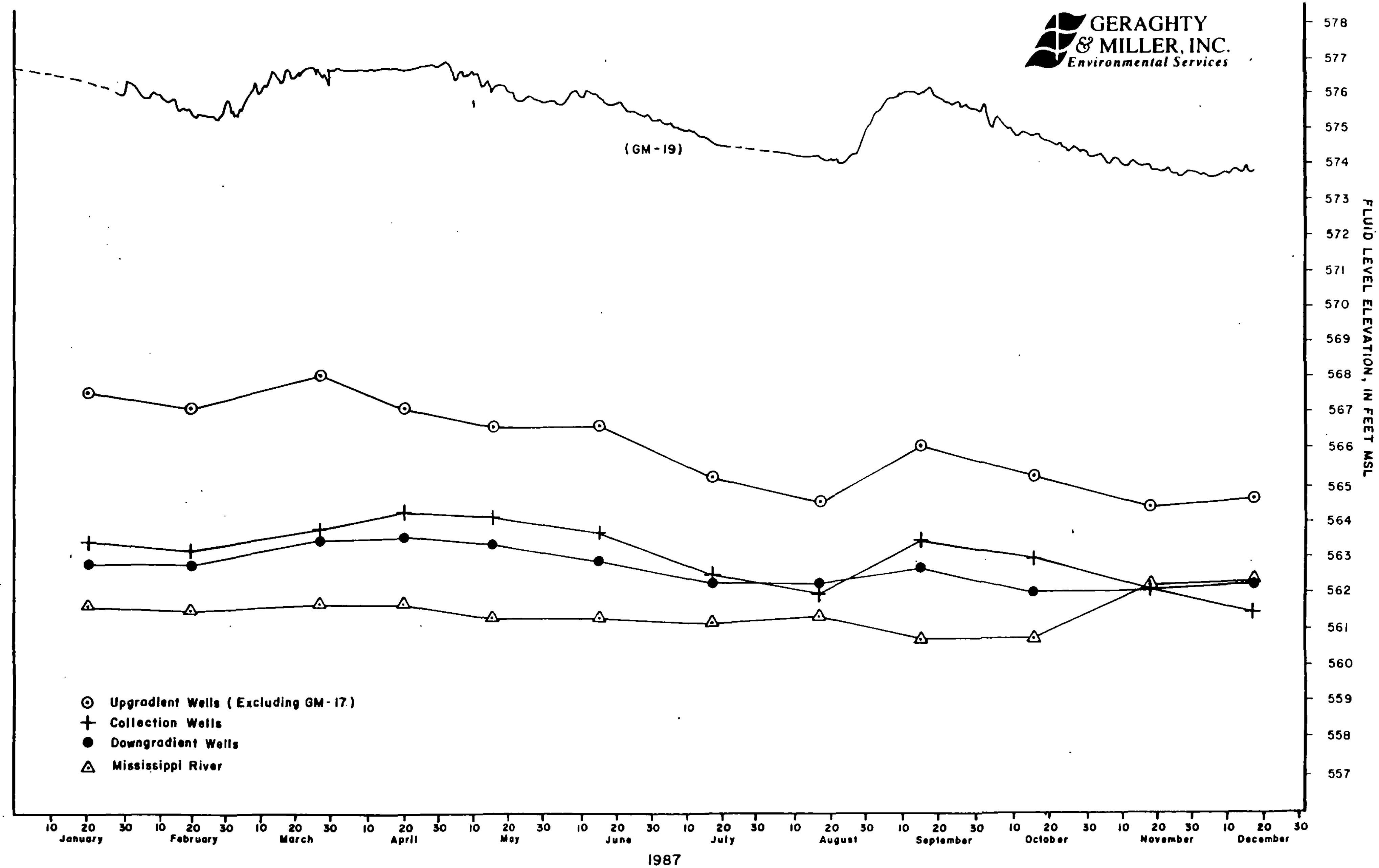


Figure 26. Hydrograph Depicting Annual Mean Fluid-Level Fluctuations for the Alcoa Waste Site and the Mississippi River During 1987.

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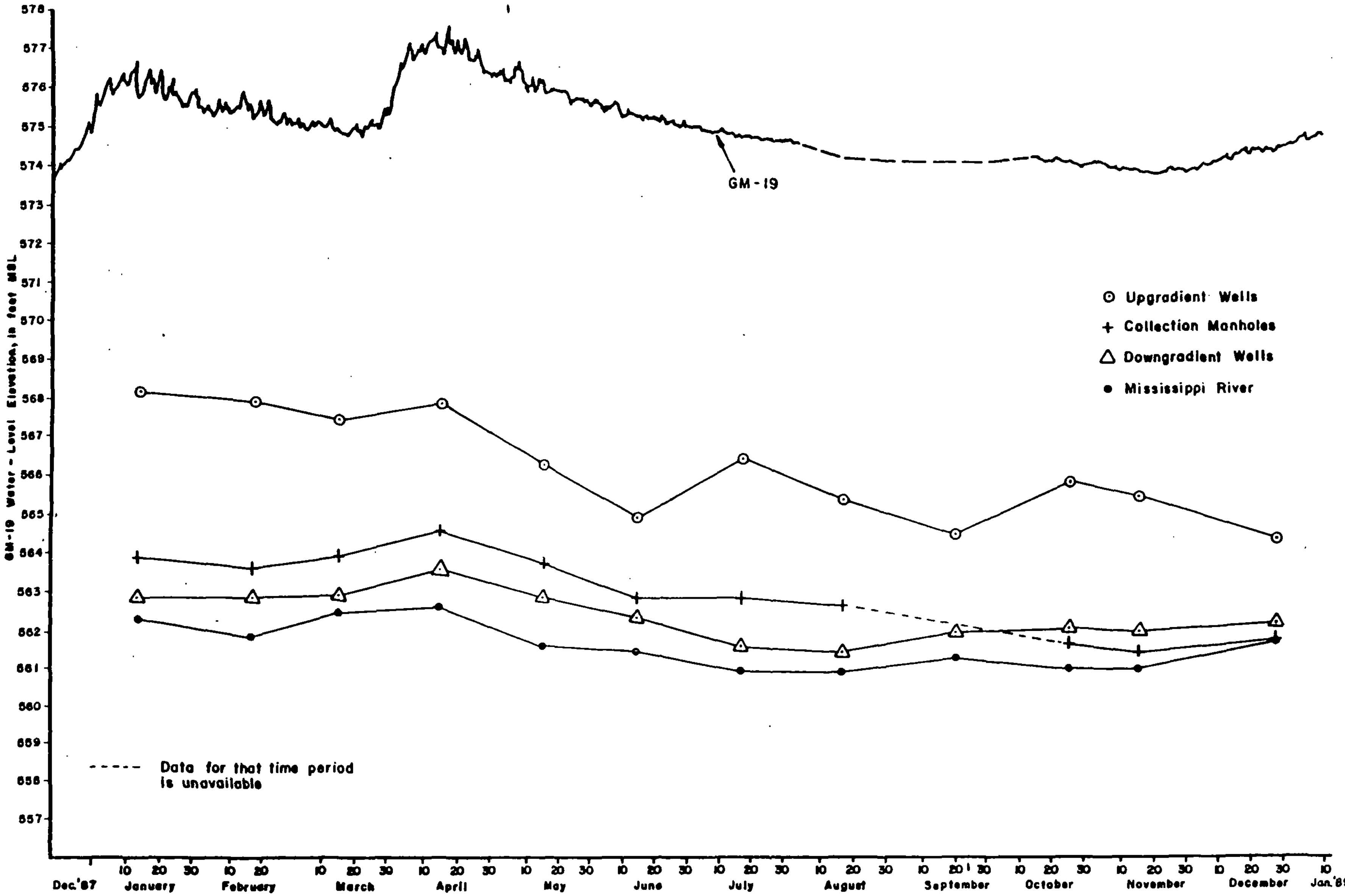


Figure 27. Hydrograph Depicting Annual Mean Fluid-Level Fluctuations for the Alcoa Waste Site and the Mississippi River During 1988.

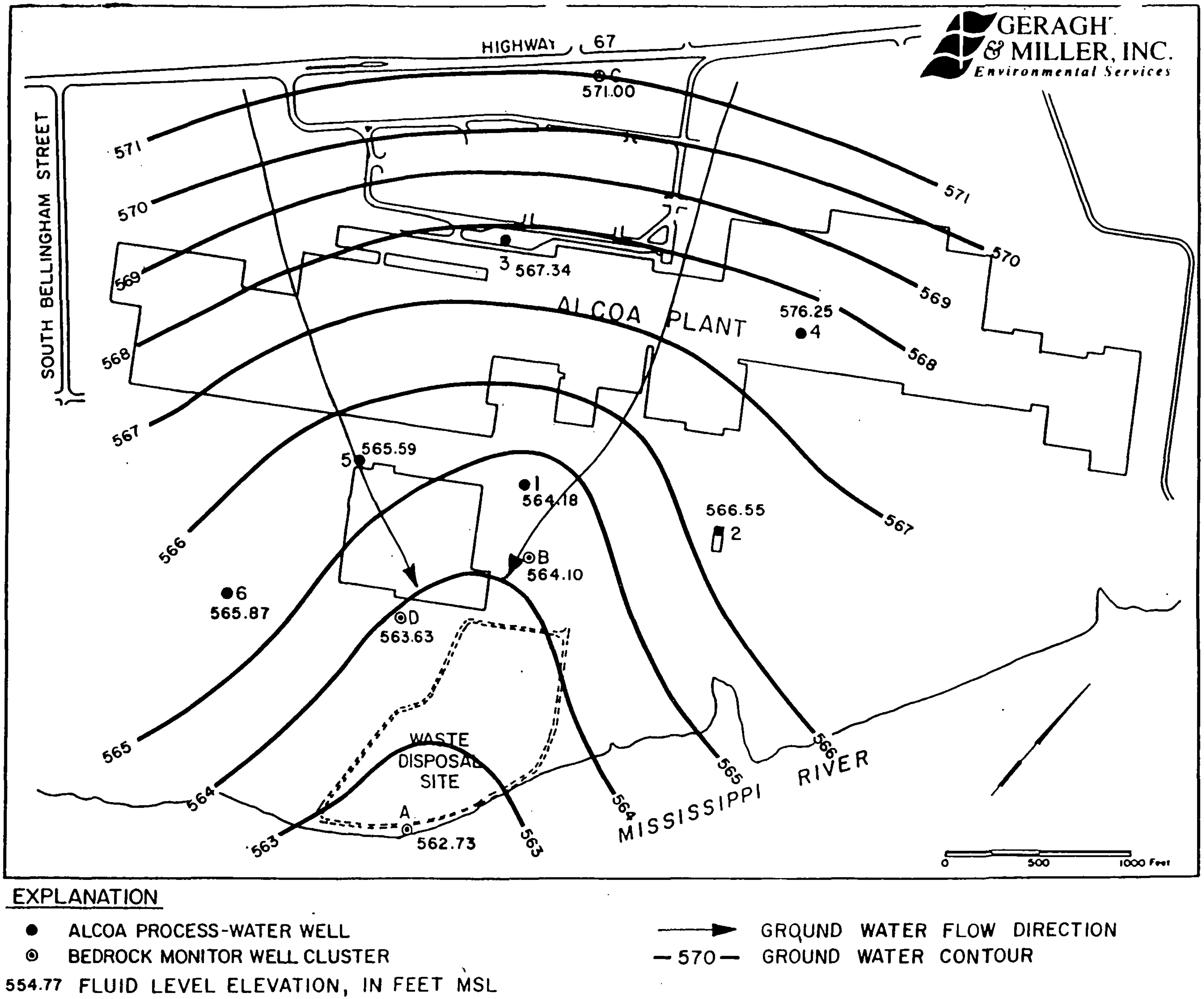
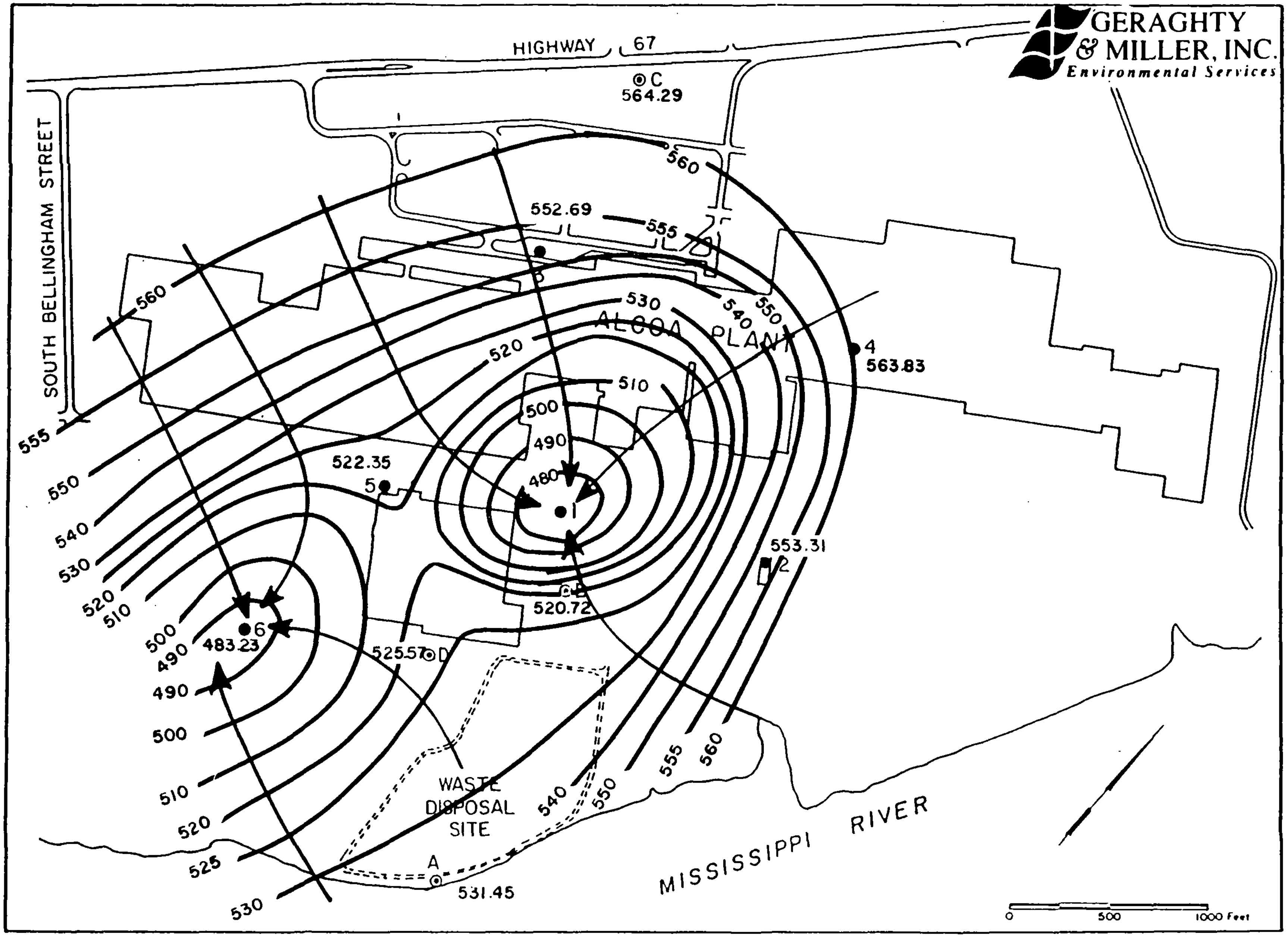


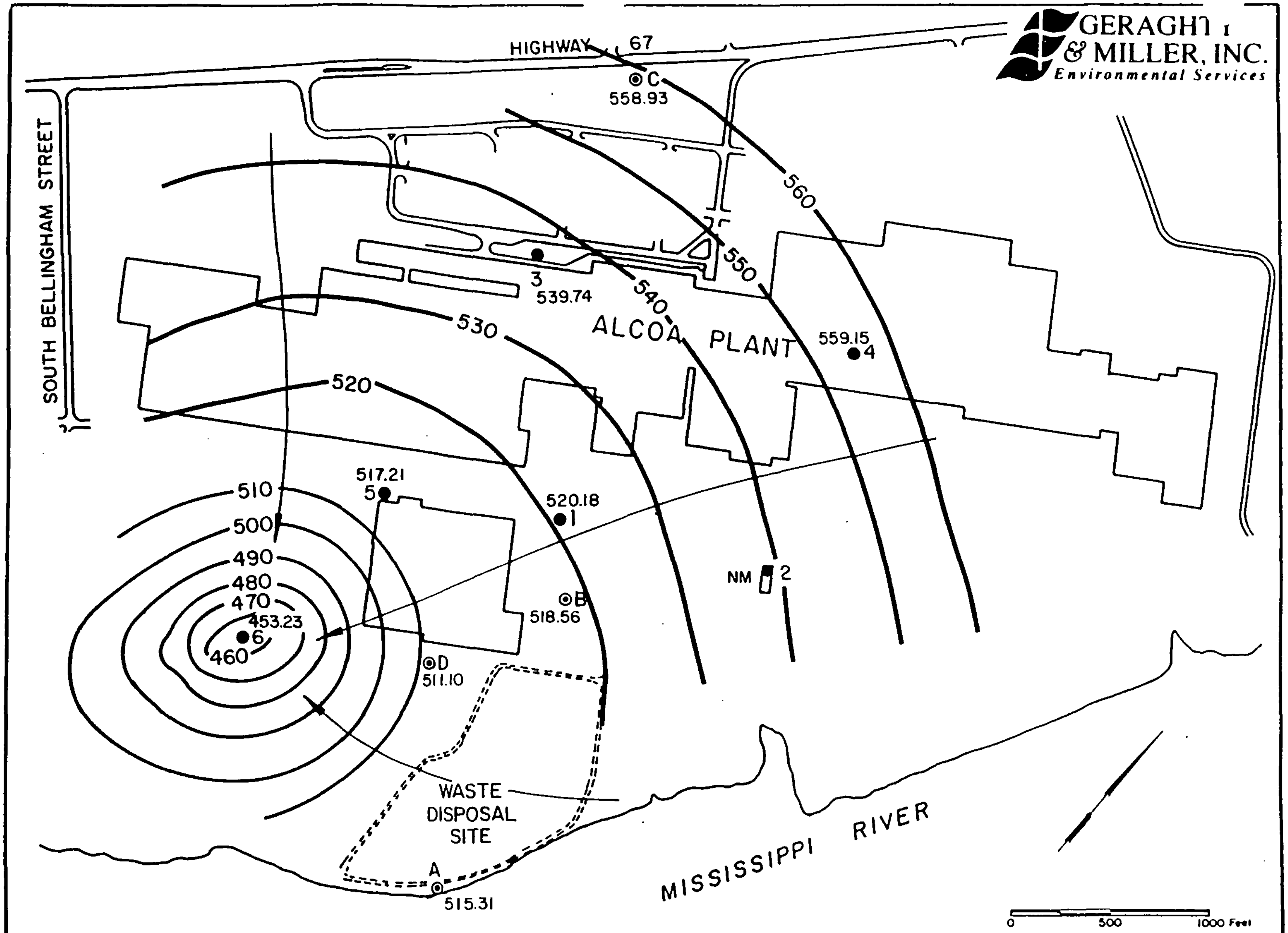
Figure 28. Ground-Water Contour Map Depicting Flow Conditions in the Bedrock Aquifer During April, 1988.



EXPLANATION

- ● ALCOA PROCESS-WATER WELL
- ⊙ BEDROCK MONITOR WELL CLUSTER
- 554.77 Fluid Level Elevation, in feet MSL
- → GROUND WATER FLOW DIRECTION
- —570— GROUND WATER CONTOUR

Figure 29. Ground-Water Contour Map Depicting Flow Conditions in the Bedrock Aquifer During June, 1988.



EXPLANATION

● ALCOA PROCESS-WATER WELL

◎ BEDROCK MONITOR WELL CLUSTER

—560— GROUND WATER CONTOUR

GROUND WATER FLOW DIRECTION

Figure 30. Ground-Water Contour Map Depicting Flow Conditions in the Bedrock Aquifer During November, 1988.

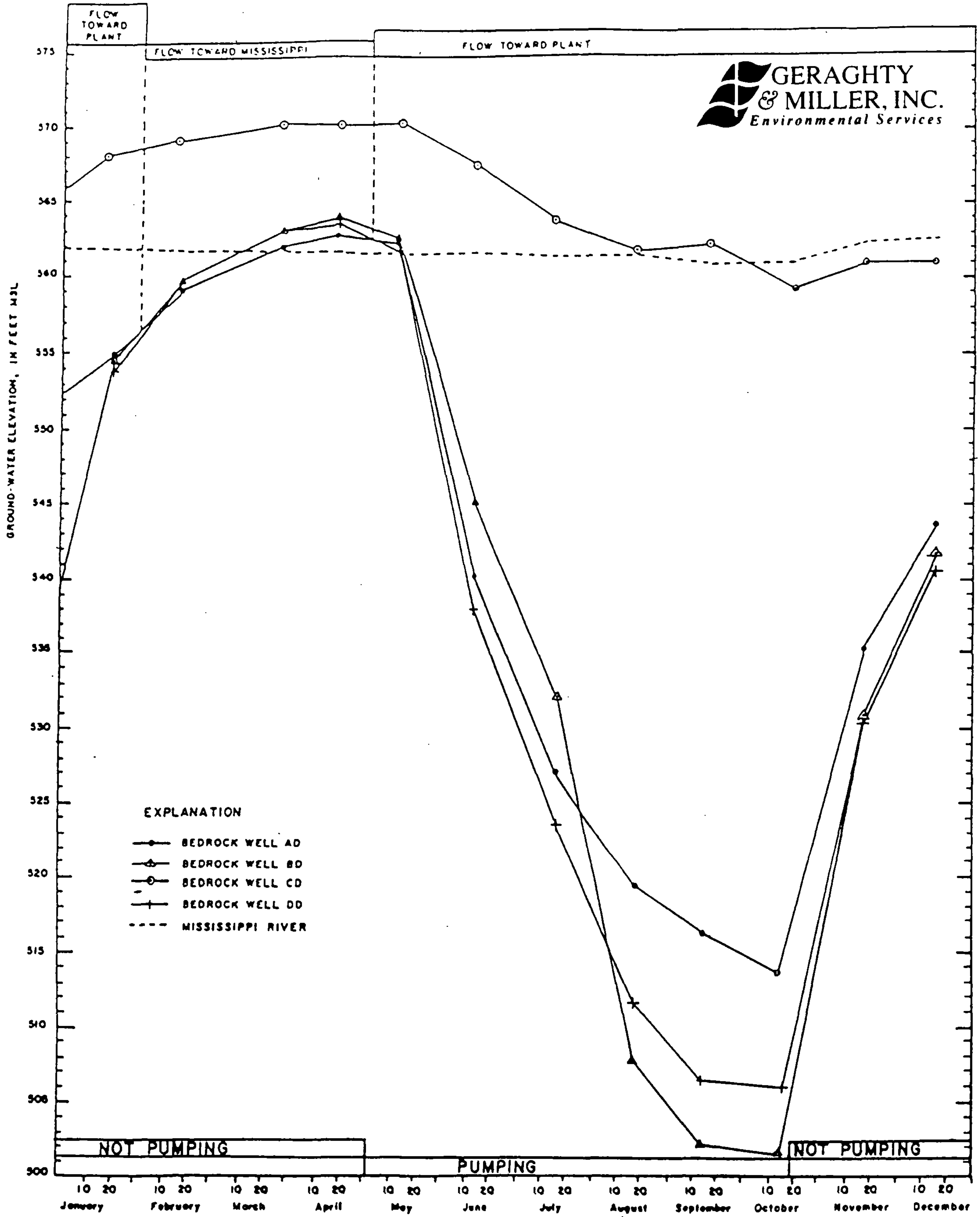
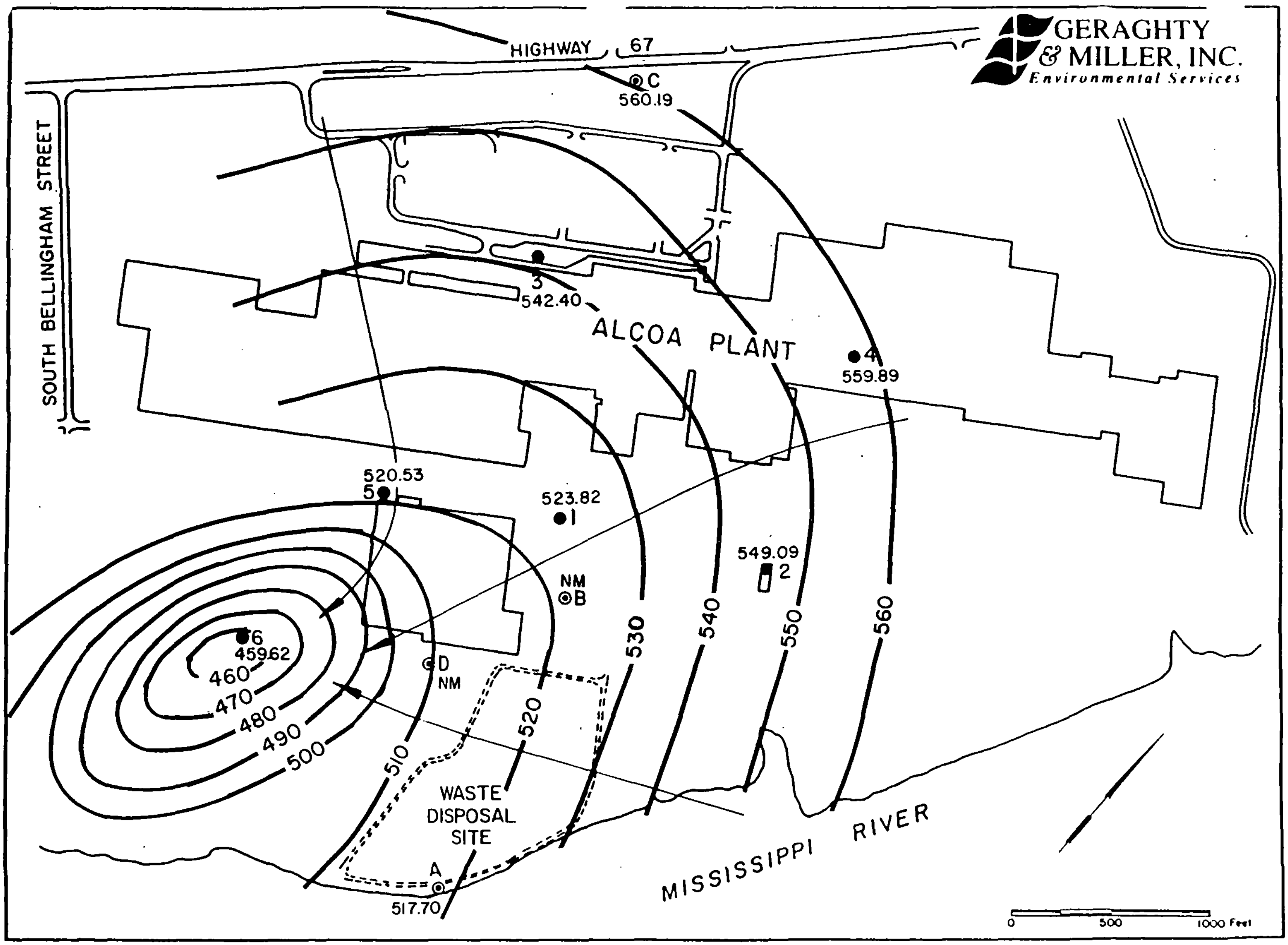


Figure 31. Hydrograph Depicting Annual Water-Level Fluctuations in Selected Bedrock Monitor Wells.



EXPLANATION

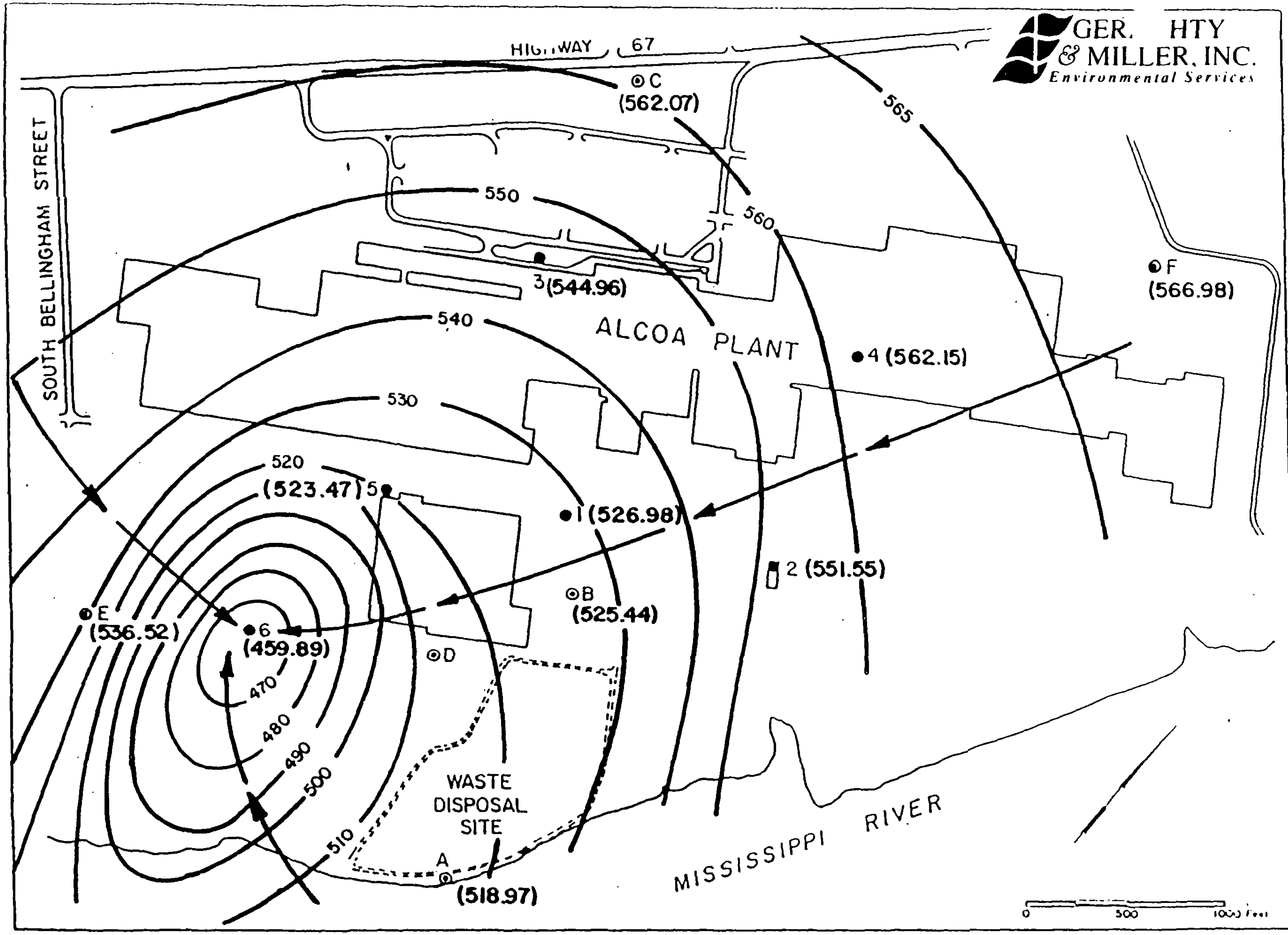
● ALCOA PROCESS-WATER WELL

◎ BEDROCK MONITOR WELL CLUSTER

—560— GROUND WATER CONTOUR

——→ GROUND WATER FLOW DIRECTION

Figure 32. Ground-Water Contour Map Depicting Flow Conditions in the Bedrock Aquifer During December, 1988.



EXPLANATION

● ALCOA PROCESS-WATER WELL

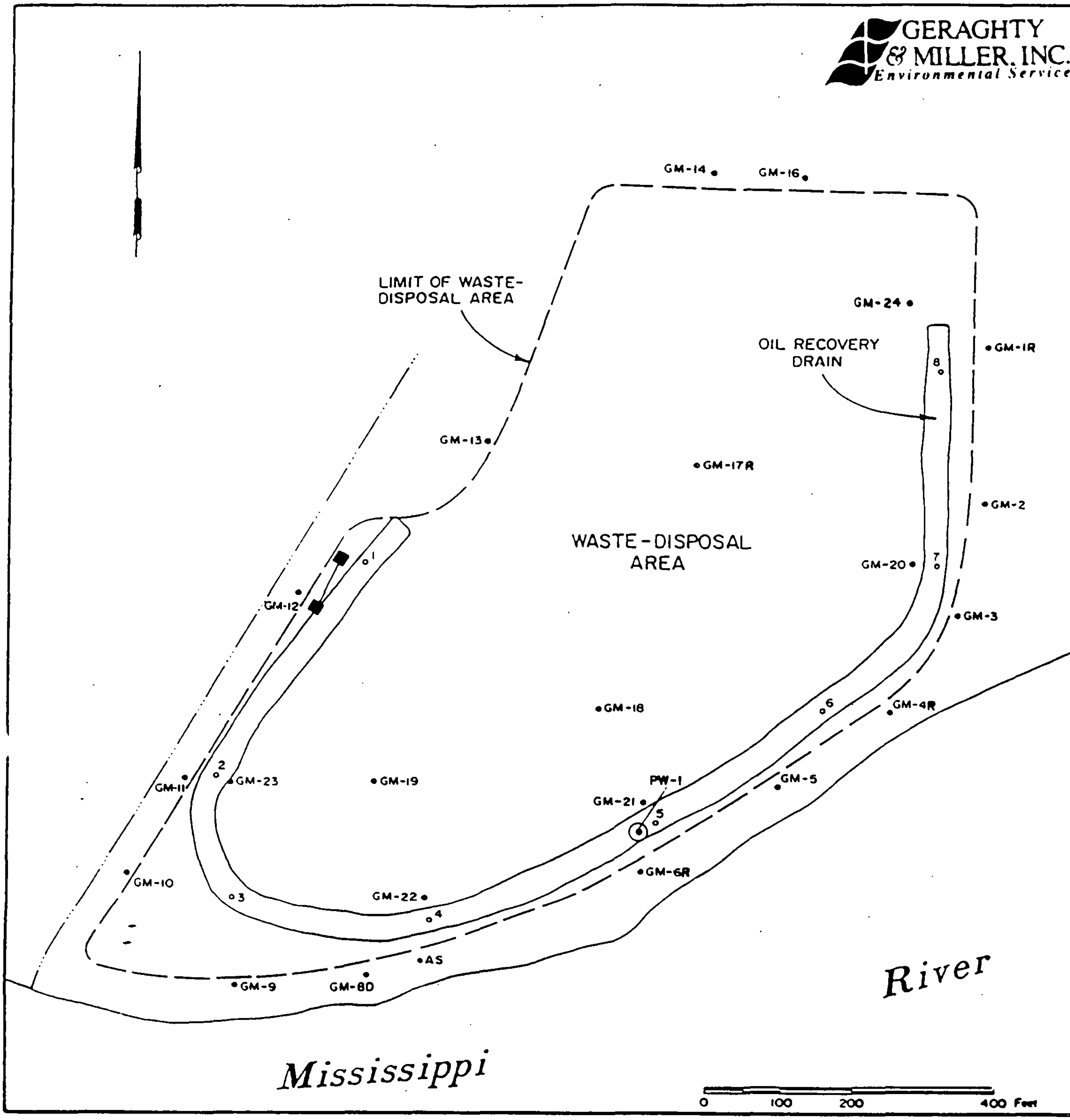
⊙ BEDROCK MONITOR WELL CLUSTER

GROUND-WATER FLOW DIRECTION

—540— GROUND-WATER CONTOUR

(525.44) Water-Level Elevation, feet MSL, in the deep well for each monitor well cluster.

Figure 33. Ground-Water Contour Map Depicting Flow Conditions in the Bedrock Aquifer During March, 1989.



EXPLANATION

- GM-16 Monitor Well
- 8 Collection Well
- GM-17R Replacement Well, Installed April, 1989
- Approximate Location of former Well PW-1.
- Approximate Location of the former N-Drain.

Figure 34. Approximate Locations of the Former Well PW-1 and the N-Drain at the Alcoa-Davenport Waste Site.

BACKGROUND WELL TO COMPLIANCE WELL COMPARISONS

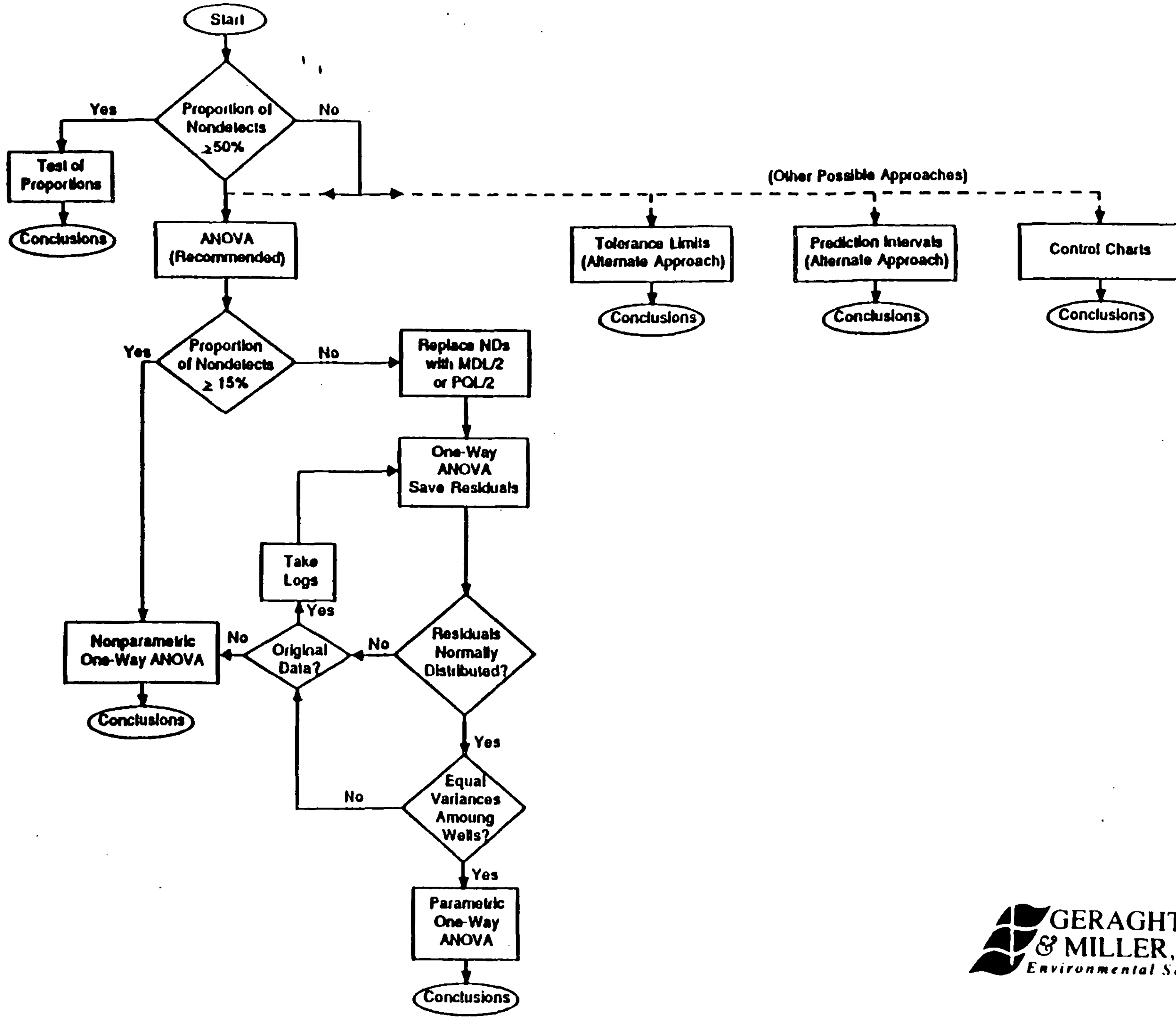


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FIGURE 35: BACKGROUND WELL TO COMPLIANCE WELL COMPARISONS, FROM EPA PB89-151047, FEB 89

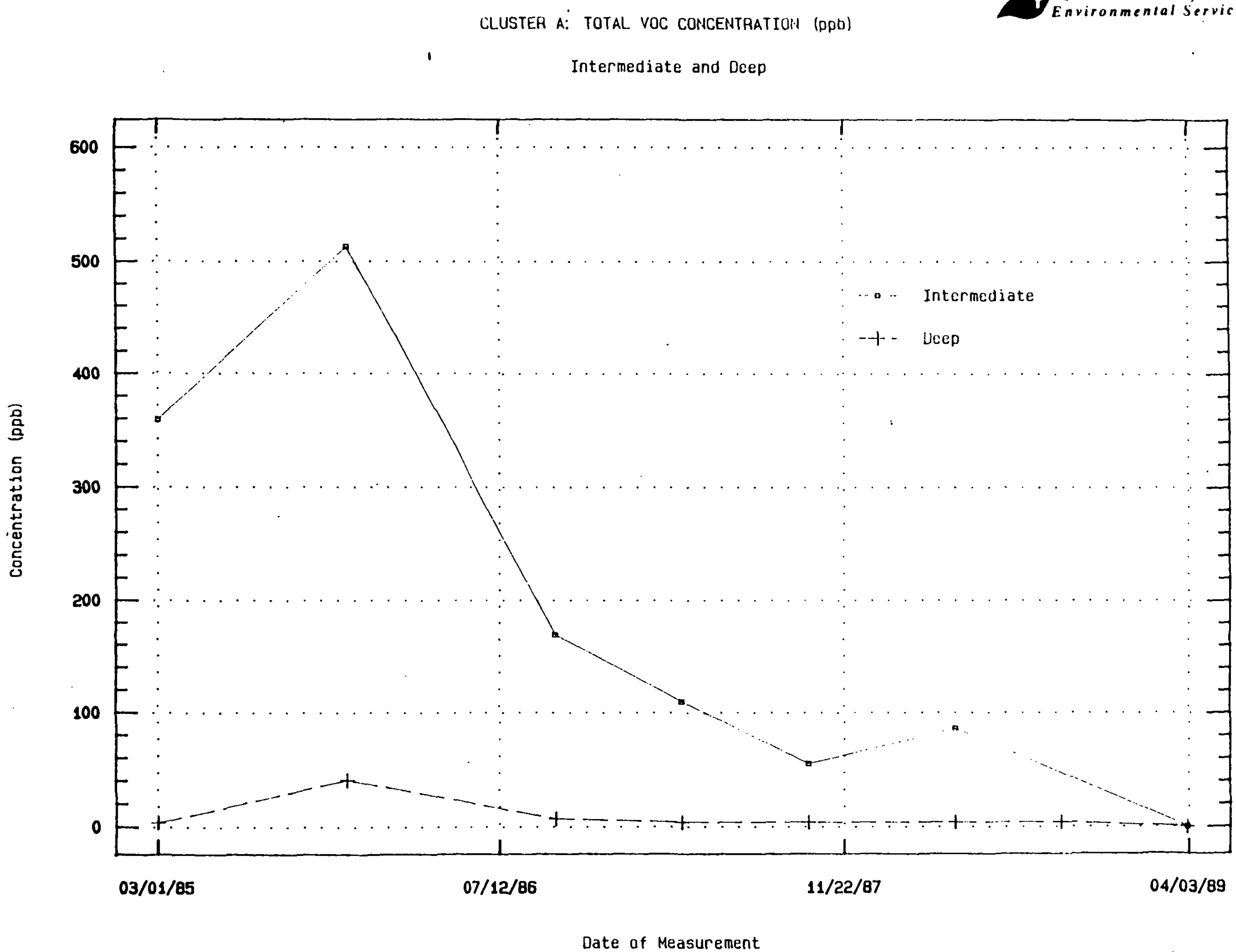

Figure 36. Time Versus Concentration Plot for Total VOCs in Bedrock Well Cluster A.

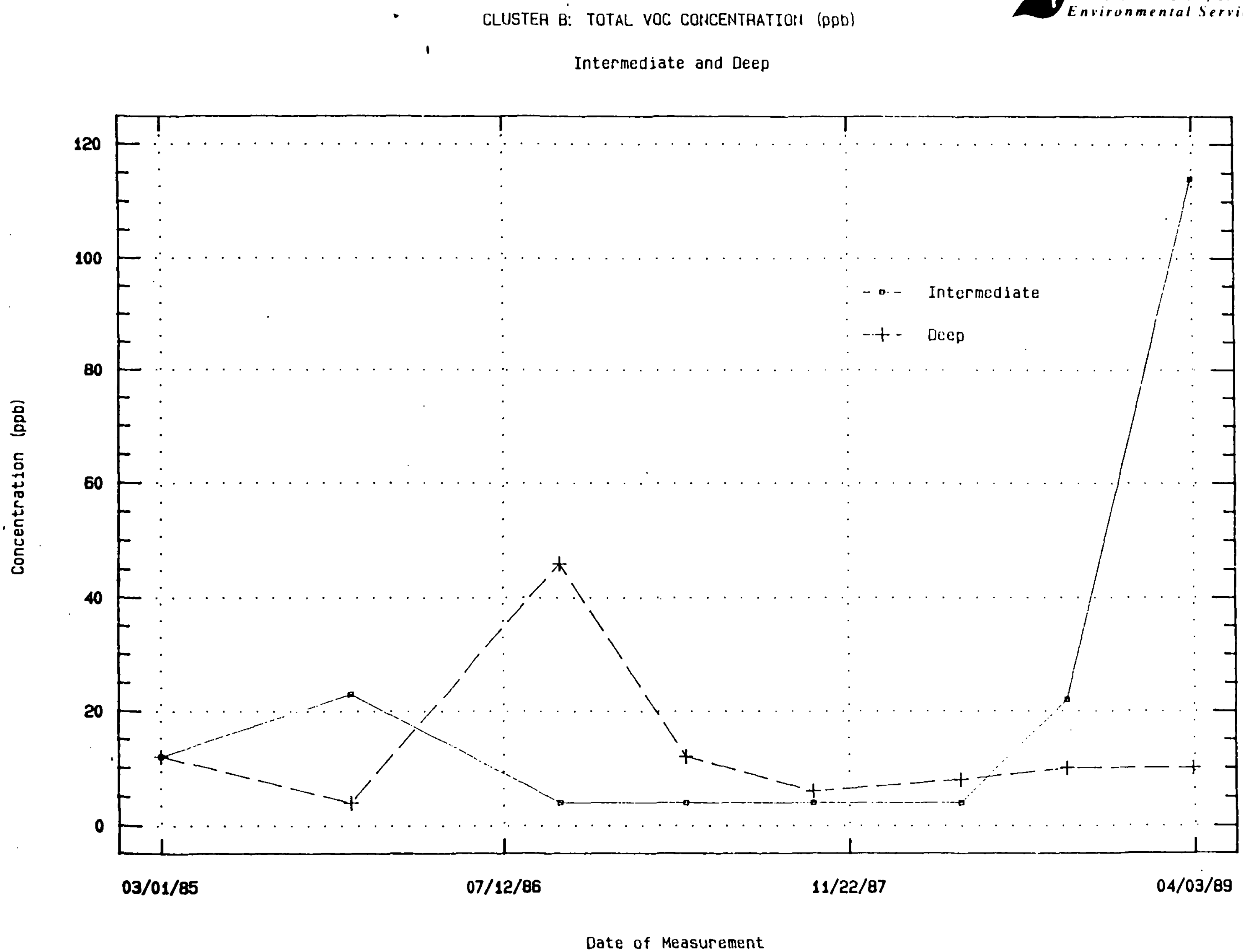

Figure 37. Time Versus Concentration Plot for Total VOCs in Bedrock Well Cluster B.

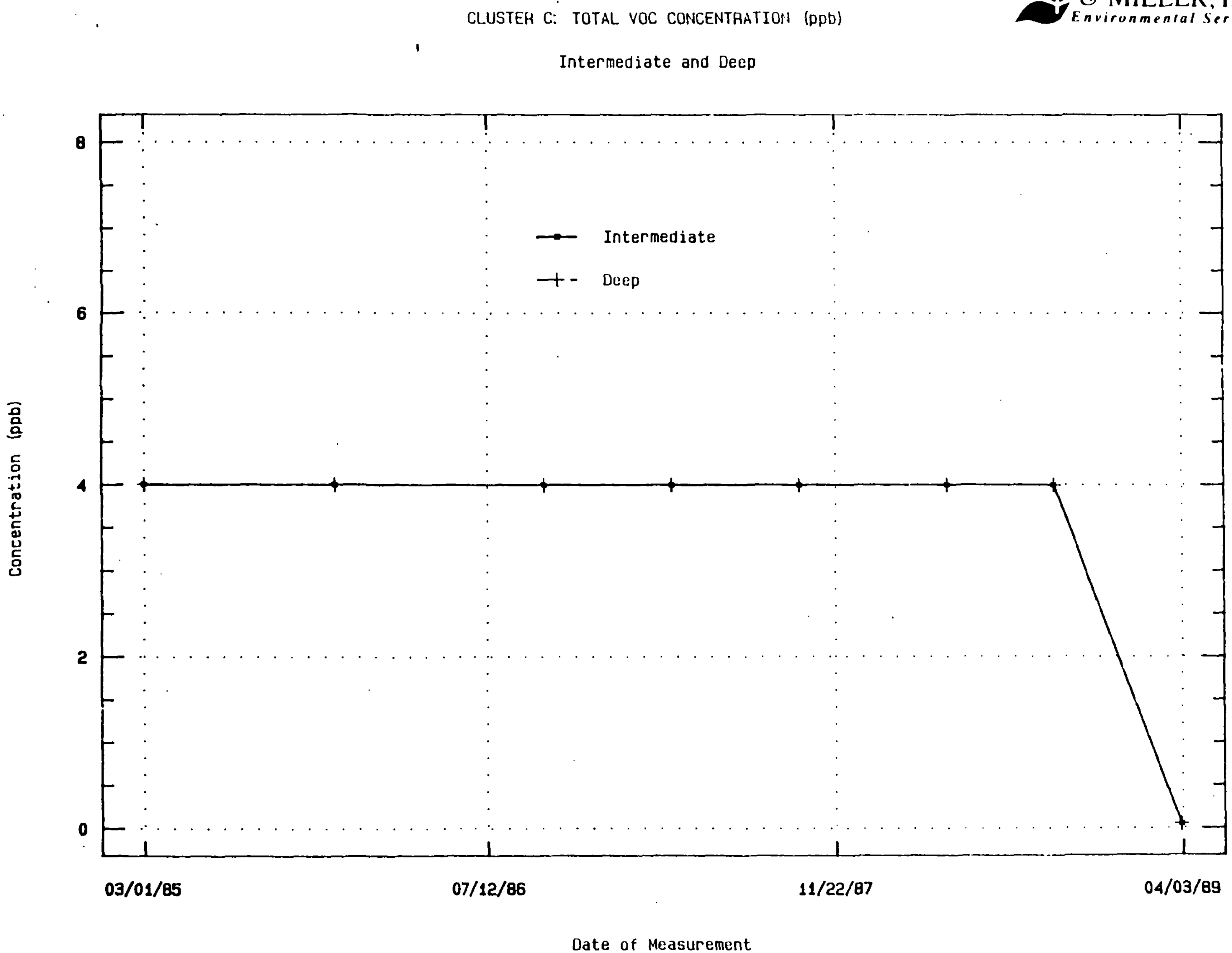

Figure 38. Time Versus Concentrations Plot for Total VOCs in Bedrock Well Cluster C.

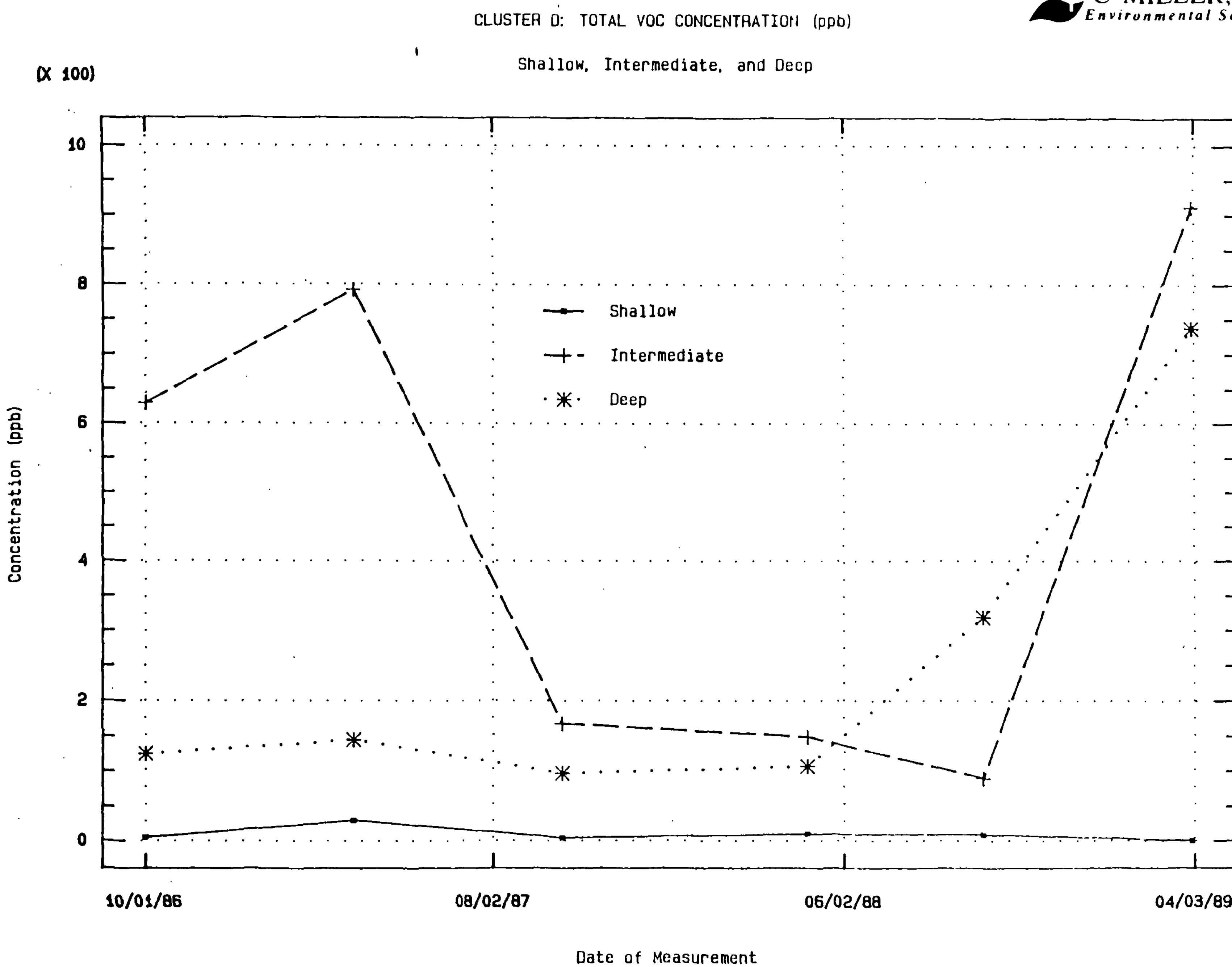

Figure 39. Time Versus Concentration Plot for Total VOCs in Bedrock Well Cluster D.

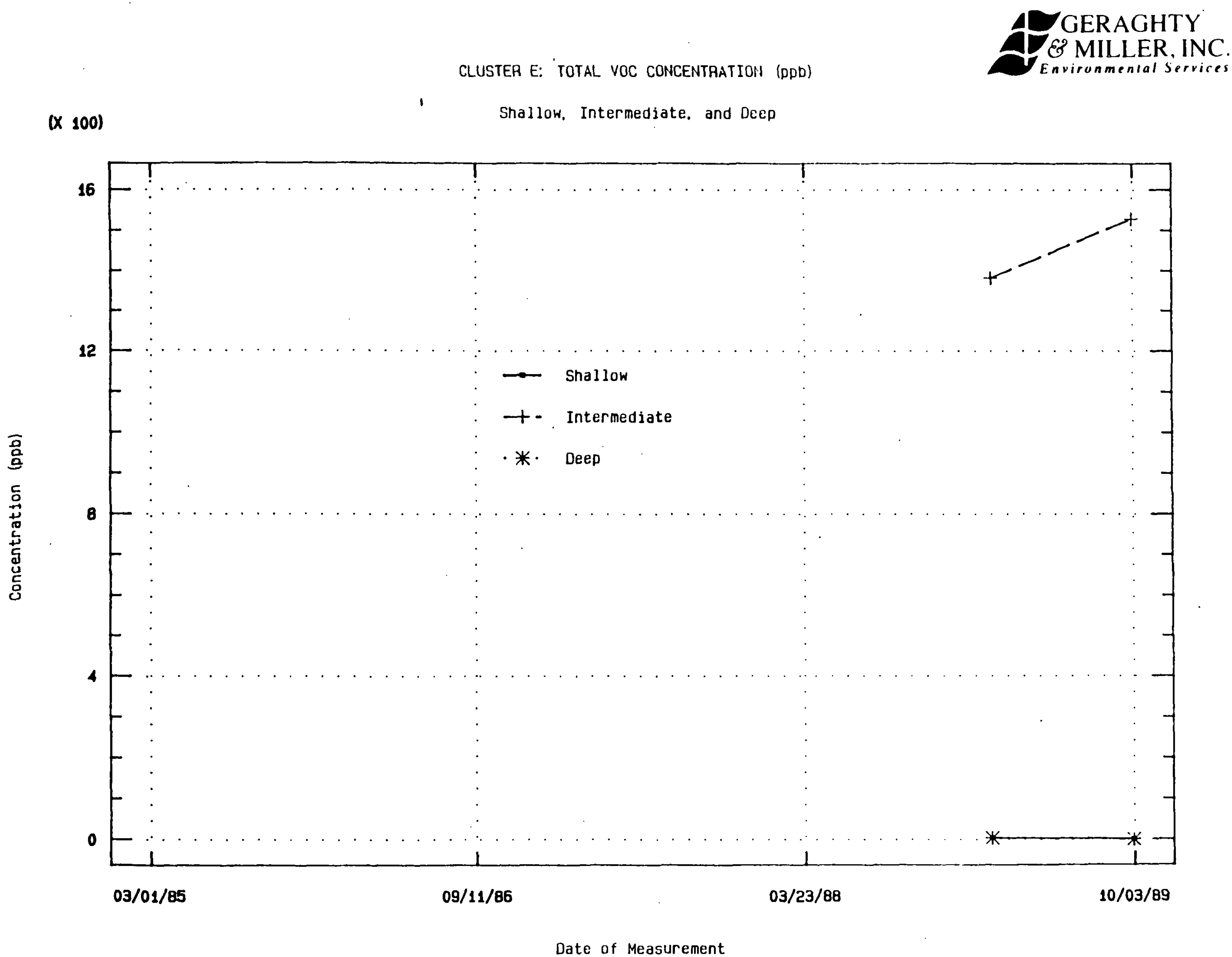

Figure 40. Time Versus Concentration Plot for Total VOCs in Bedrock Well Clsuter E.

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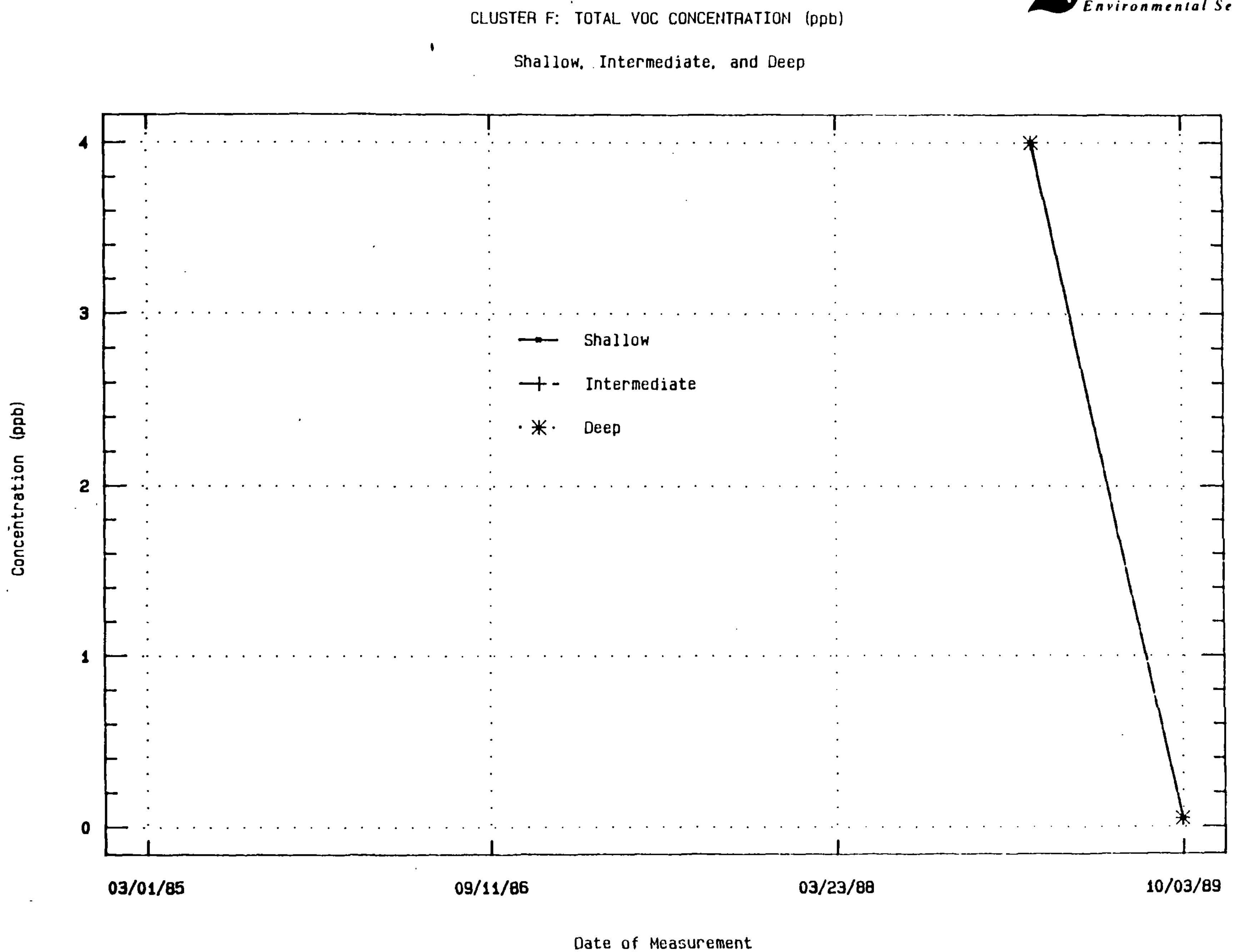

Figure 41. Time Versus Concentration Plot for Total VOCs in Bedrock Well Cluster F.

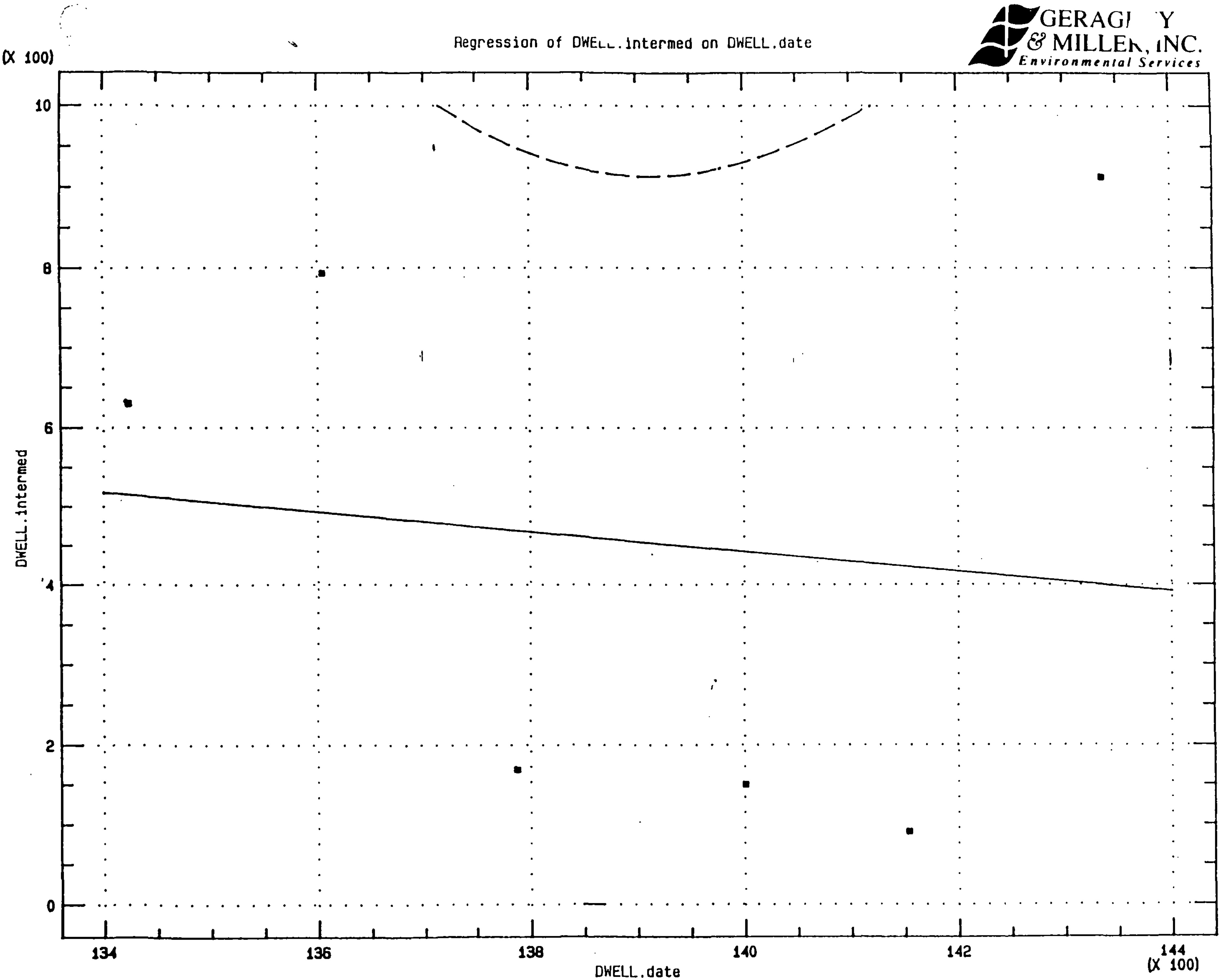

Figure 42. Regression Analysis Plot of Total VOC Data for Bedrock Well DI.

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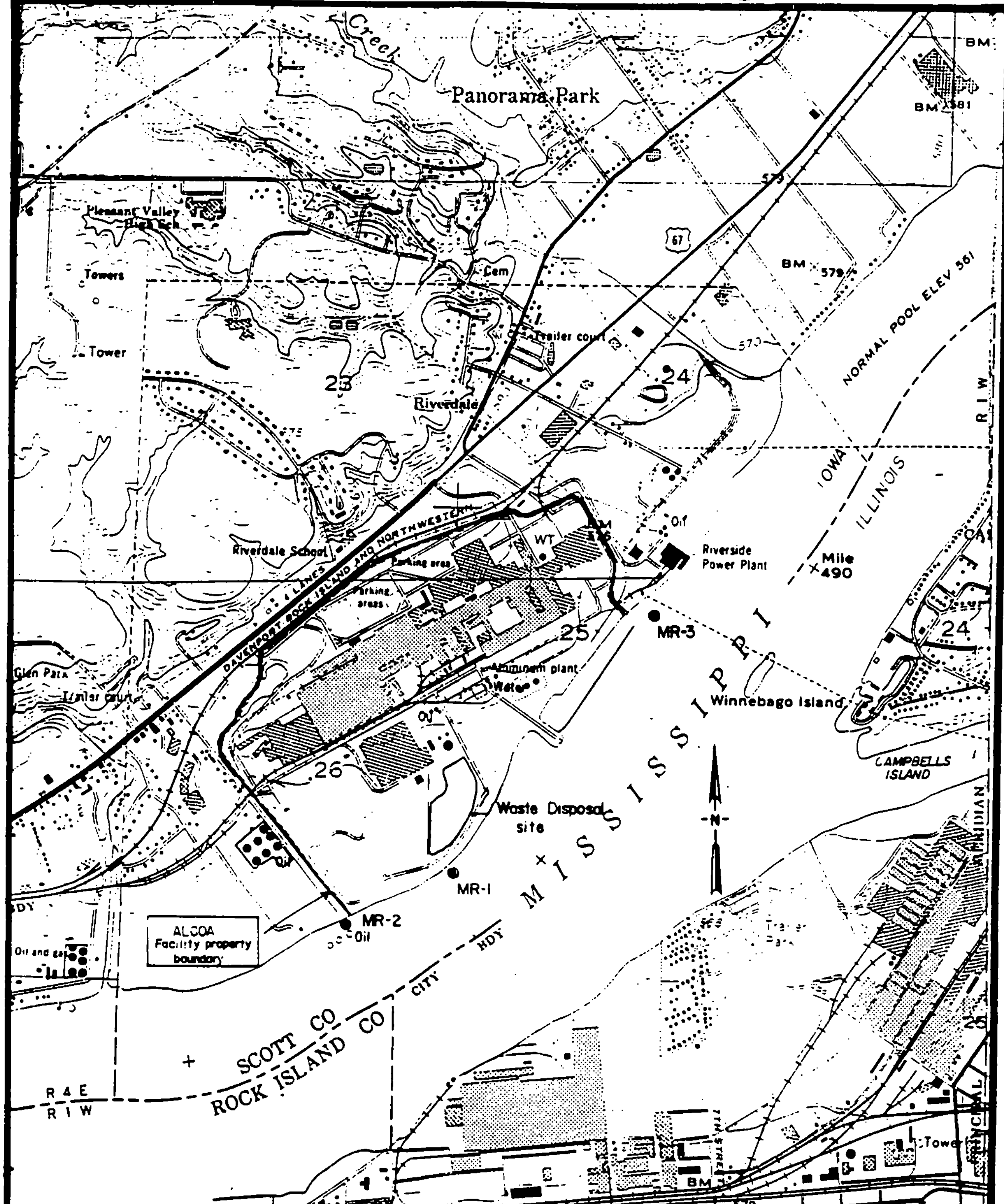
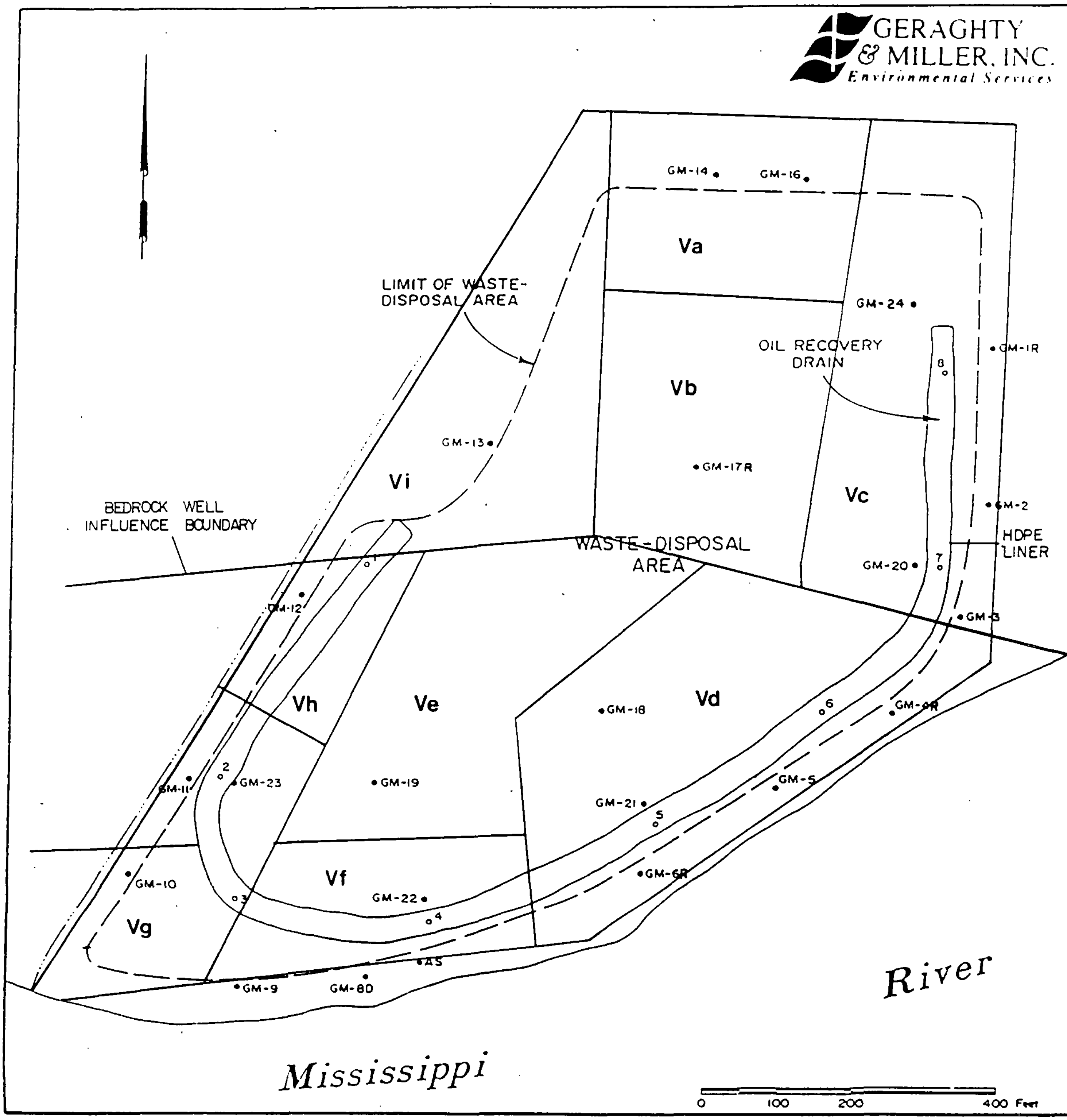


MAP FROM USGS SILVIS QUAD.

● MR-1 Mississippi River Surface-Water Sample Locations.

0 1/2 1 mile
SCALE

Figure 43. Surface Water Sampling Locations in the Mississippi River.



EXPLANATION

- GM-16 Monitor Well
- 8 Collection Well
- GM-17R Replacement Well, Installed April, 1989

Figure 44. Subdivision of the Alcoa-Davenport Waste Site into Elements for Computation of Vertical Ground-Water Flux Component.

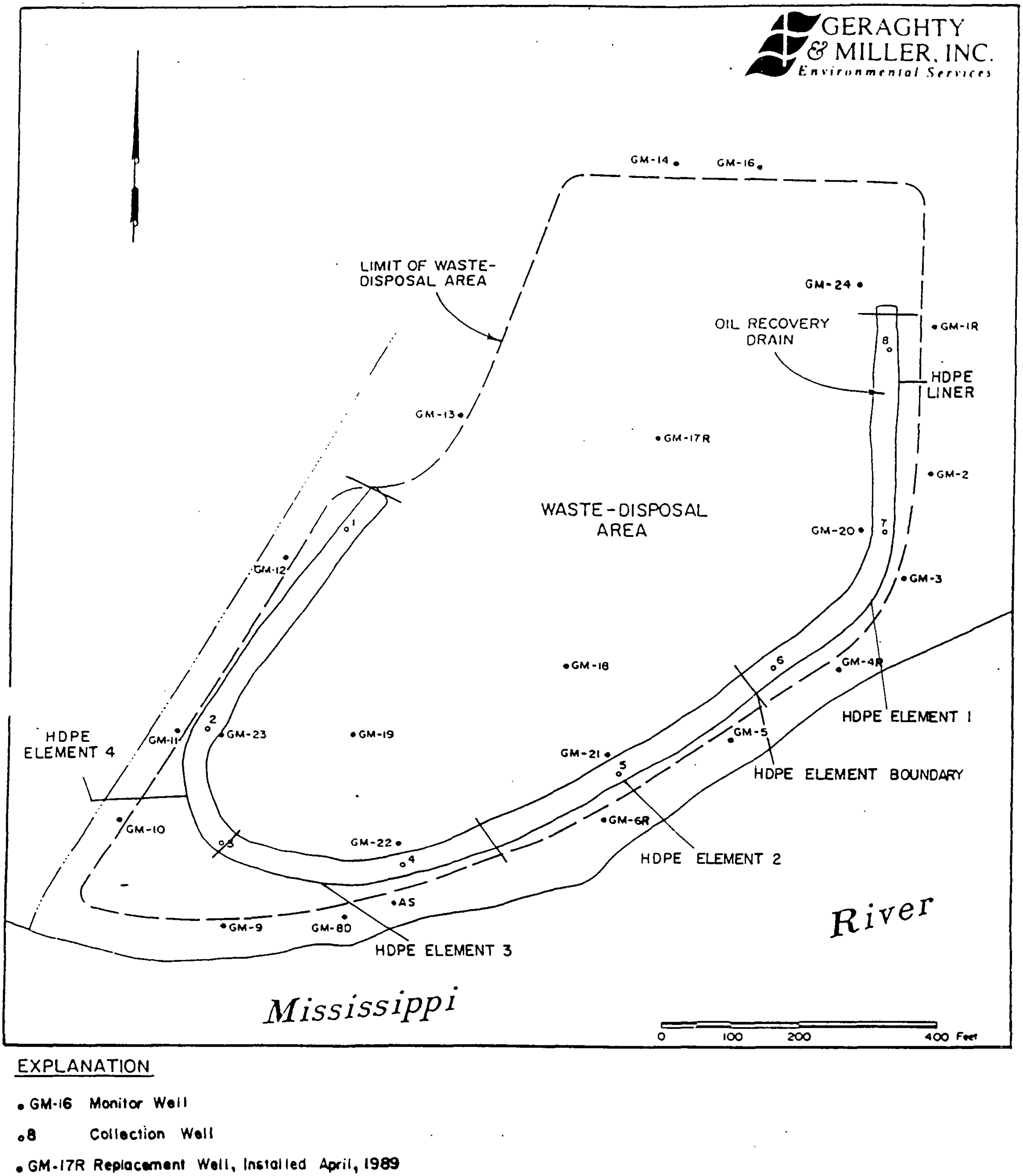


Figure 45. Location of the Four Curvilinear Elements of the HDPE Liner Used to Estimate the Horizontal Components of Ground-Water Flux at the Alcoa-Davenport Waste Site.

HYDRAULIC GRADIENTS ACROSS THE HDPE LINER, 1987

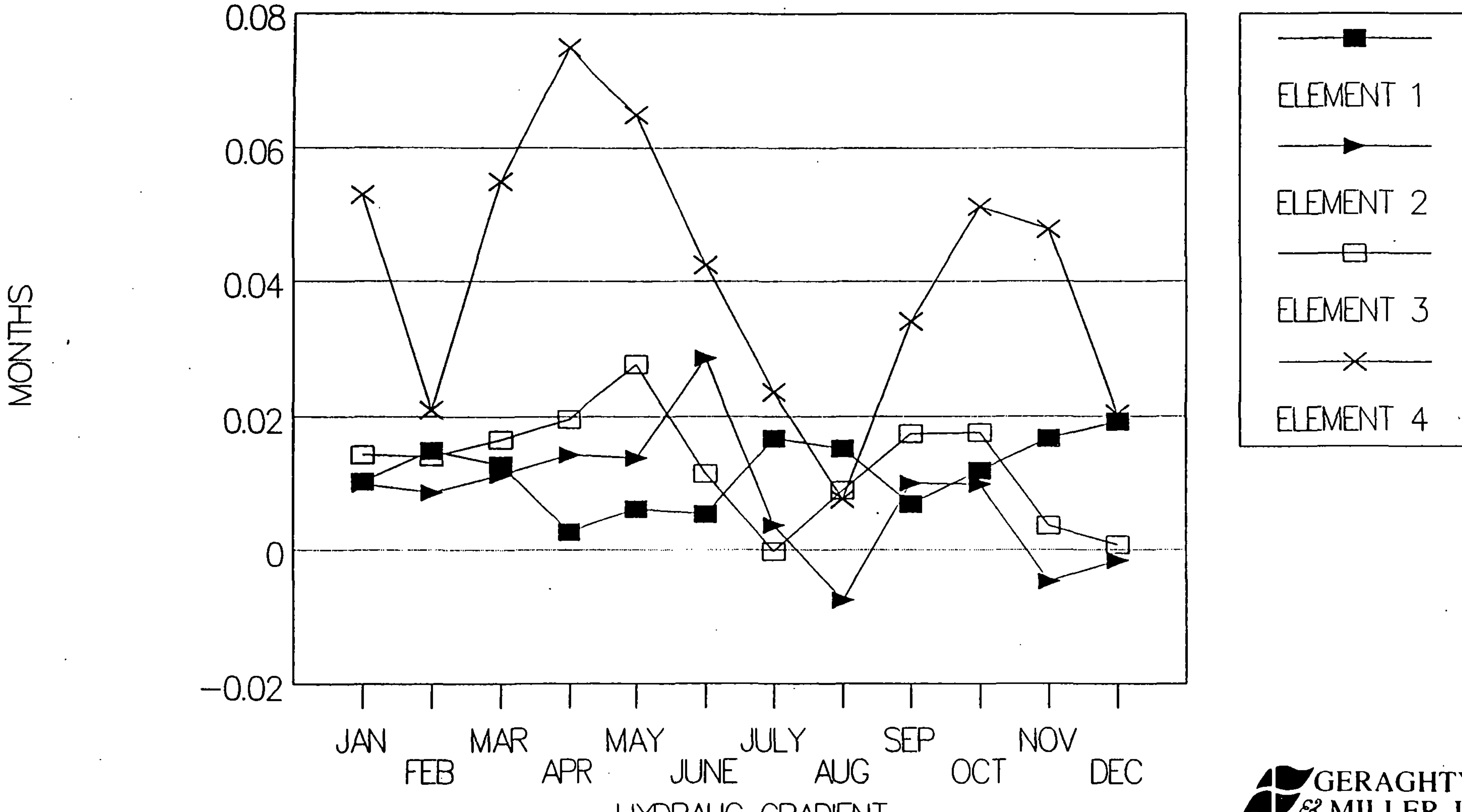


Figure 46

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HYDRAULIC GRADIENTS ACROSS THE HDPE LINER, 1988

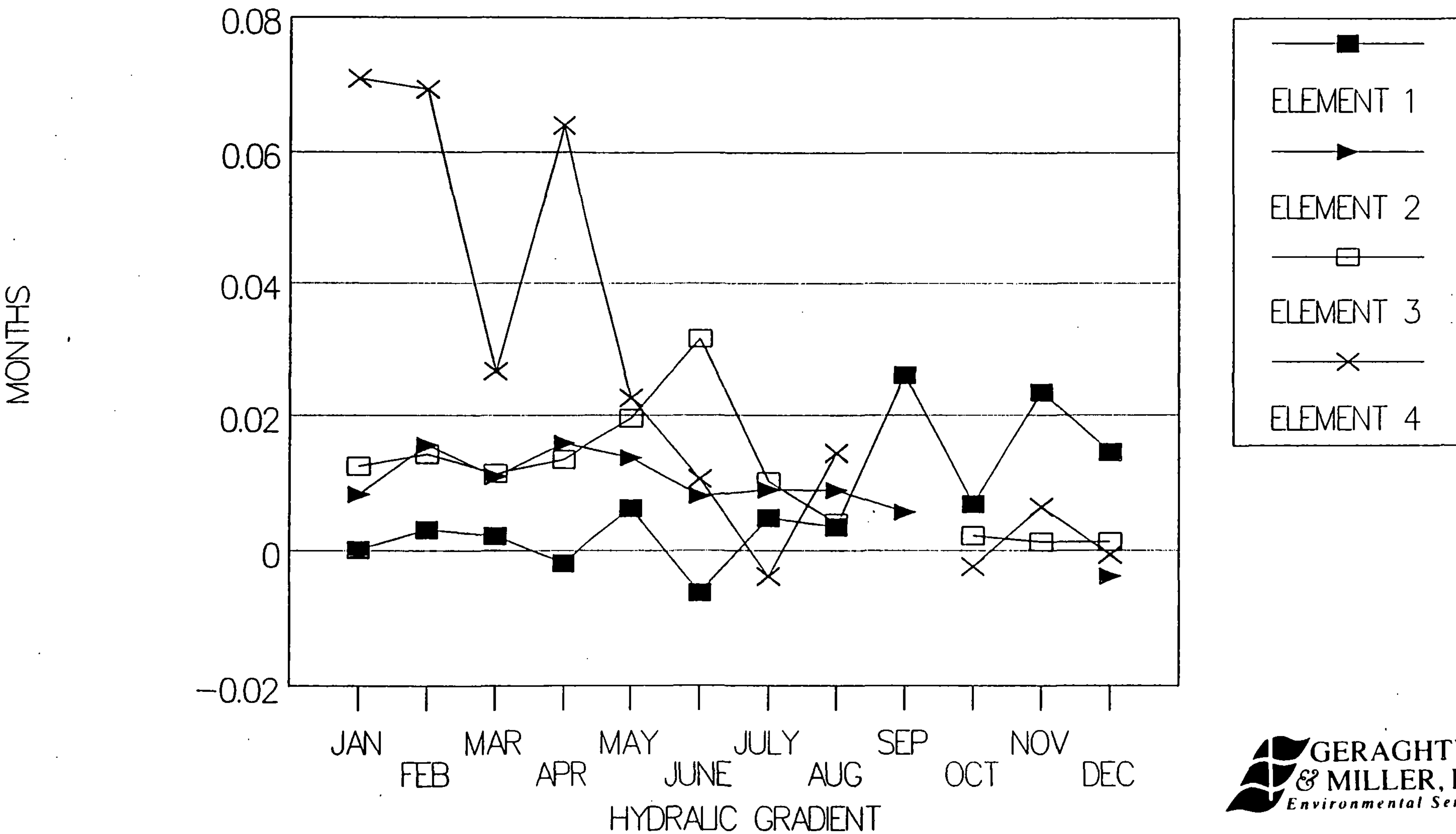

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Figure 47

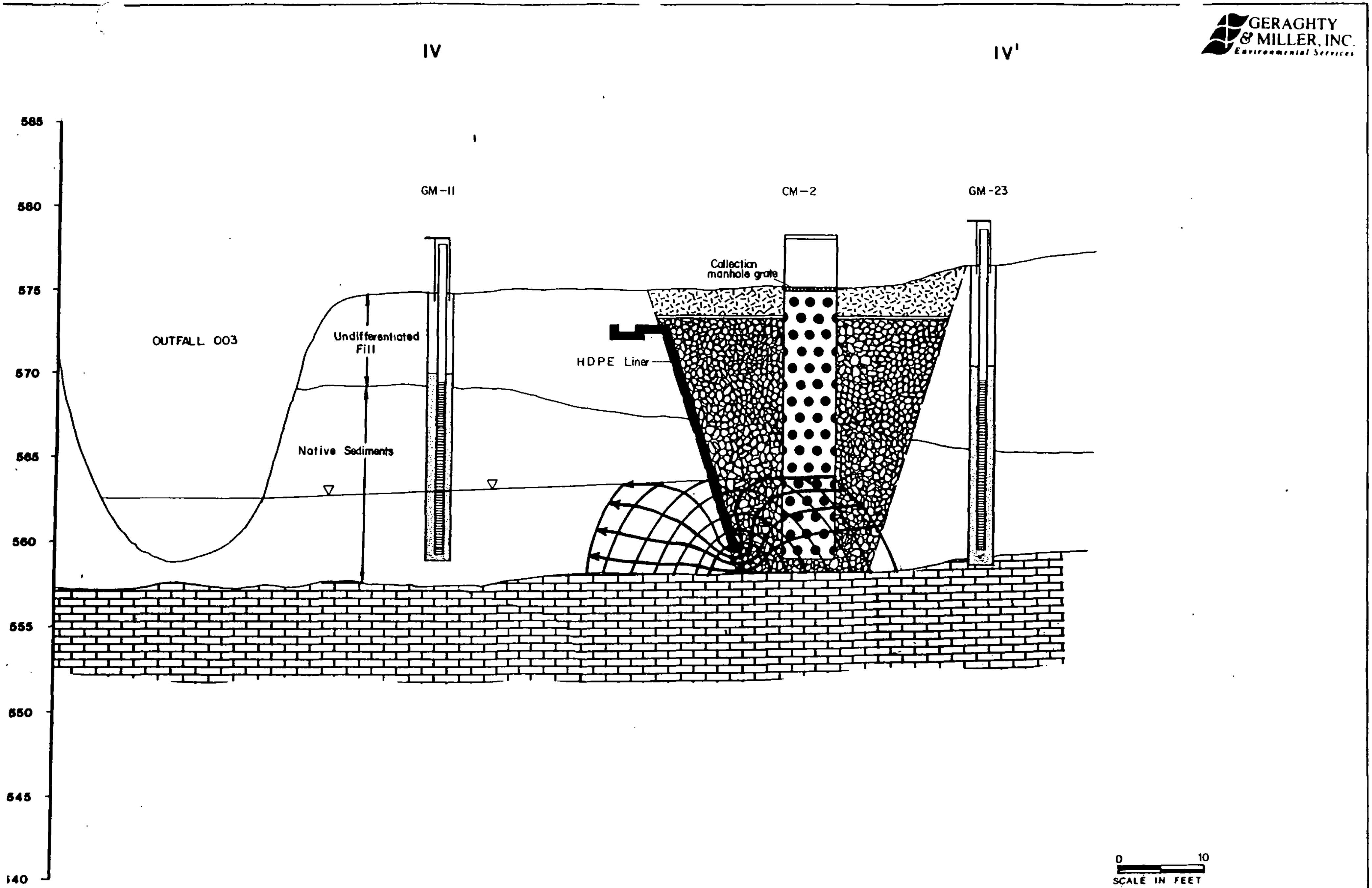

Figure 48. Flow Net Depicting Ground-Water Flow Conditions Beneath the HDPE Liner at the Alcoa-Davenport Waste Site.

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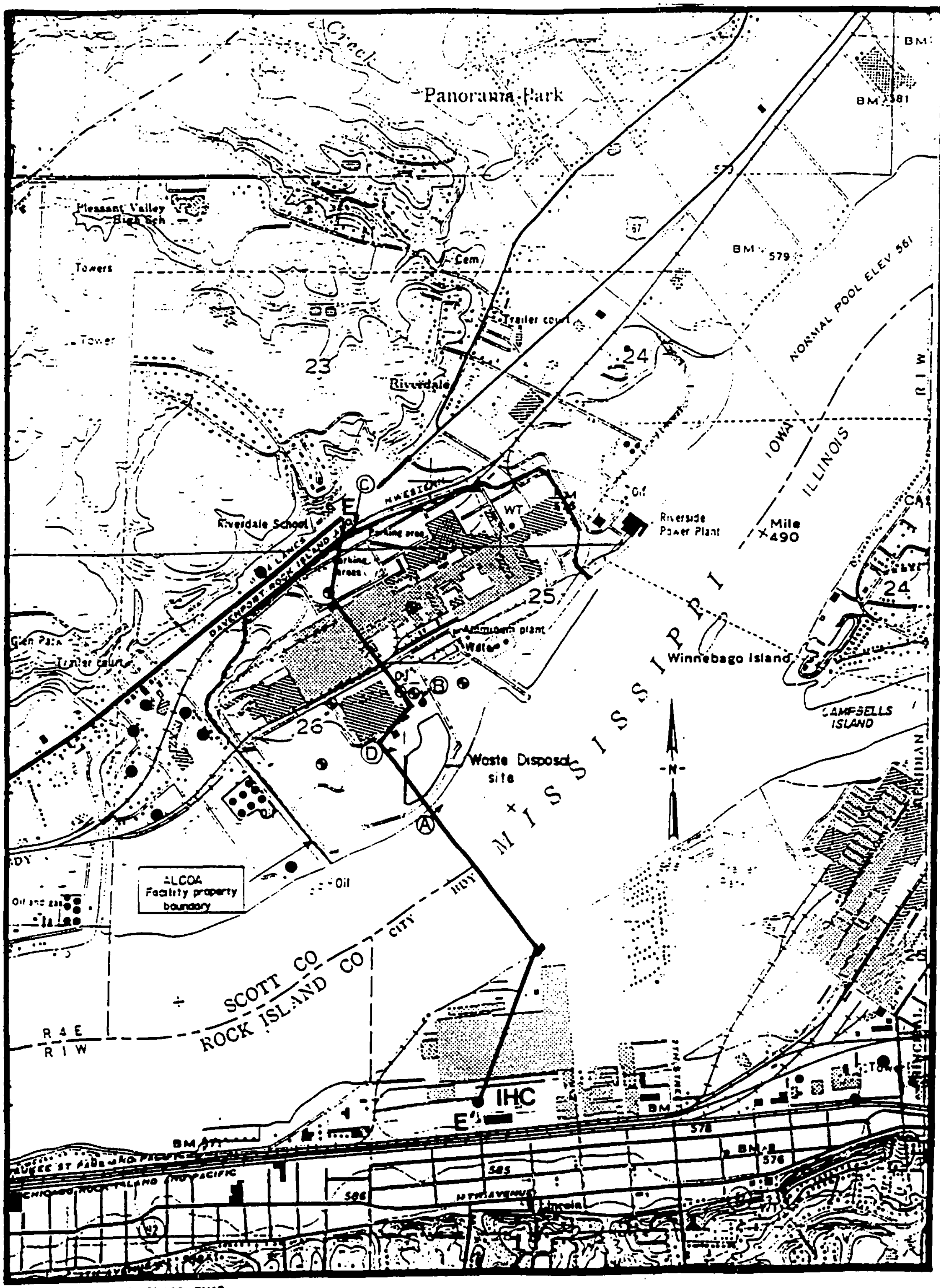
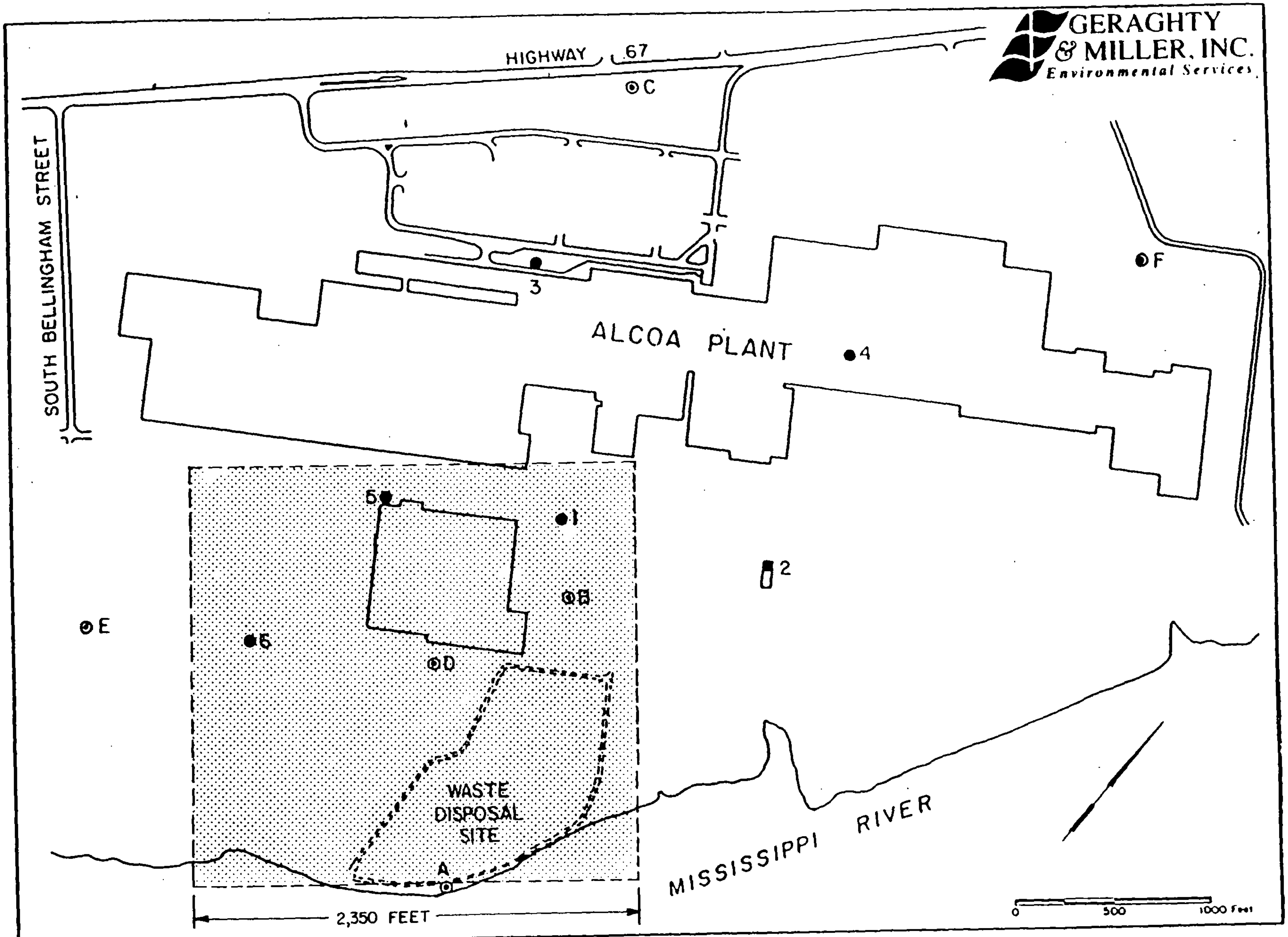


MAP FROM USGS SILVIS QUAD.

0 1/2 1 mile
SCALE

Figure 49. Location of Bedrock Cross-Section transect E-E' at the Alcoa-Davenport Plant.



EXPLANATION

● ALCOA PROCESS-WATER WELL

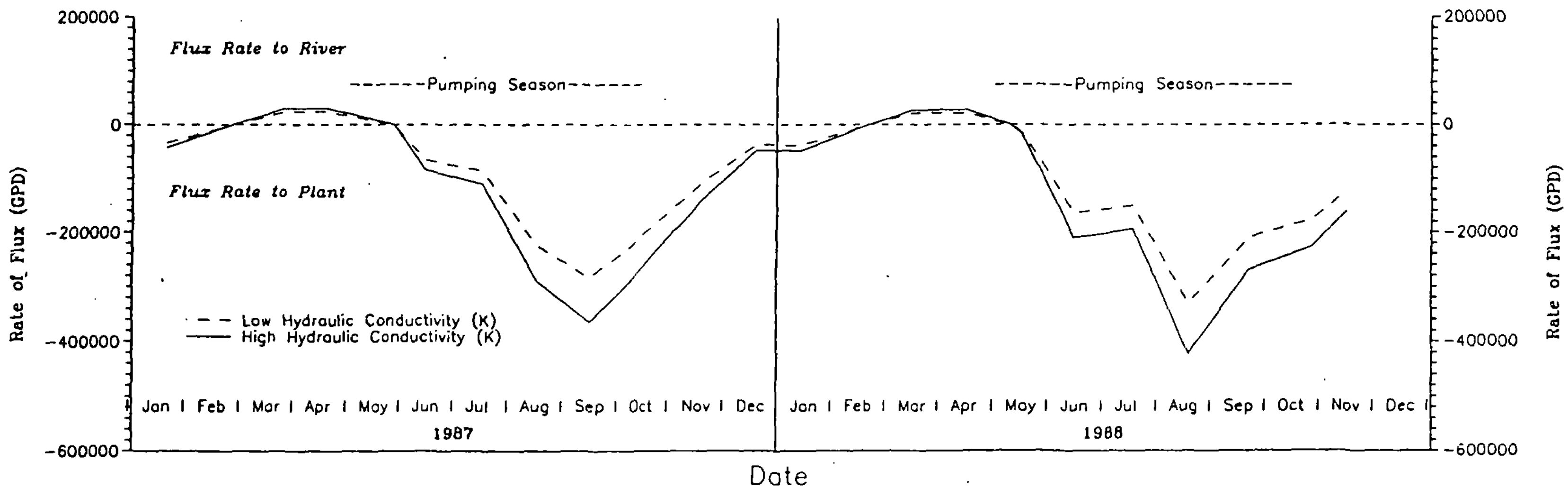
⊙ BEDROCK MONITOR WELL CLUSTER

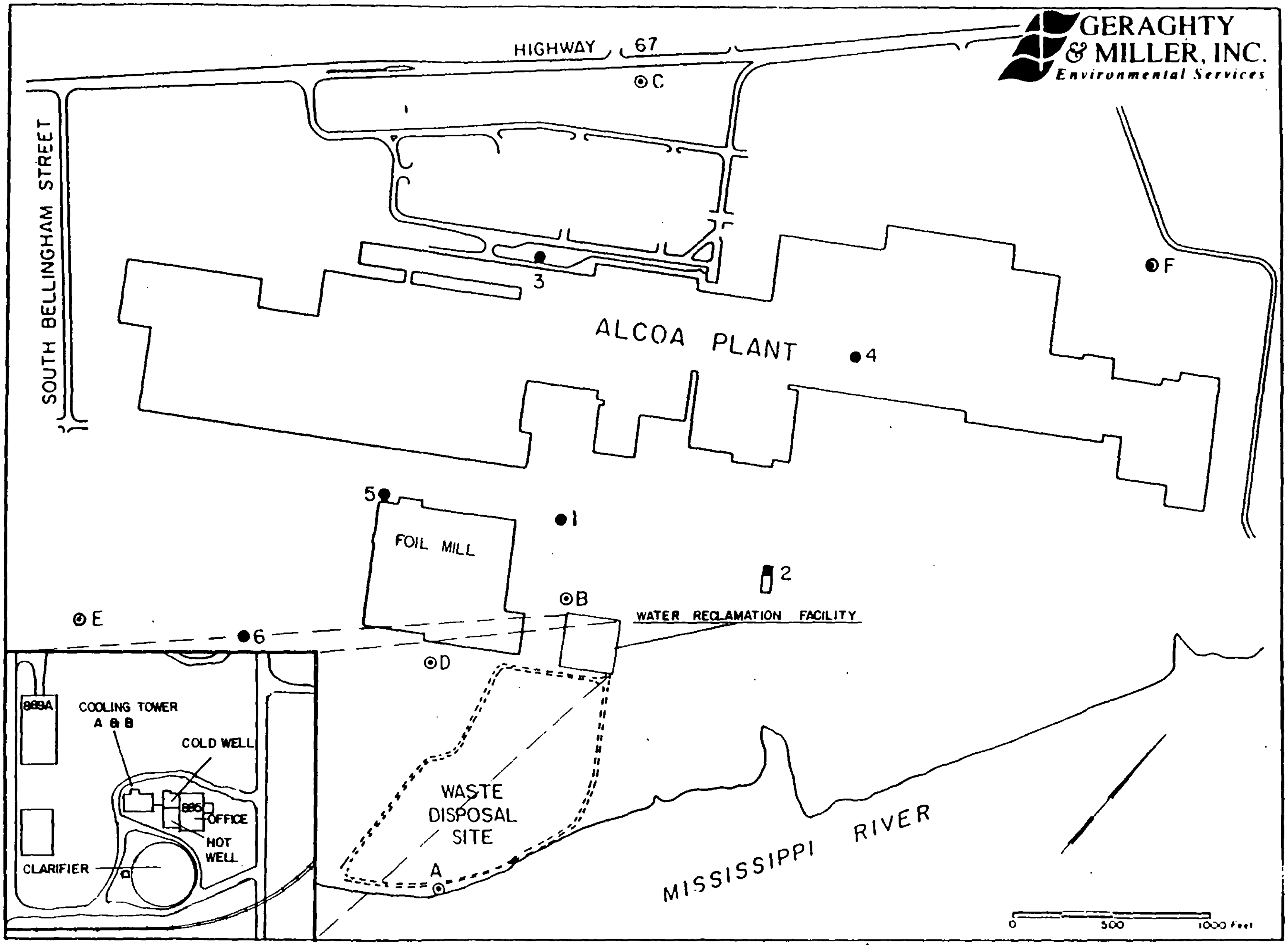
APPROXIMATE CONFIGURATION OF PORTION OF BEDROCK AQUIFER DOWNGRADIENT FROM THE WASTE SITE.

Figure 50. Approximate Areal Configuration of Portion of Bedrock Aquifer Downgradient from the Alcoa-Davenport Waste Site.

Figure 51

Ground-Water Flux from the Bedrock Aquifer to the Mississippi River for the Aloca-Davenport Site During 1987 and 1989





EXPLANATION

● ALCOA PROCESS-WATER WELL

⊙ BEDROCK MONITOR WELL CLUSTER

Figure 52. Water Reclamation Facility Site Map at the Alcoa-Davenport Plant.

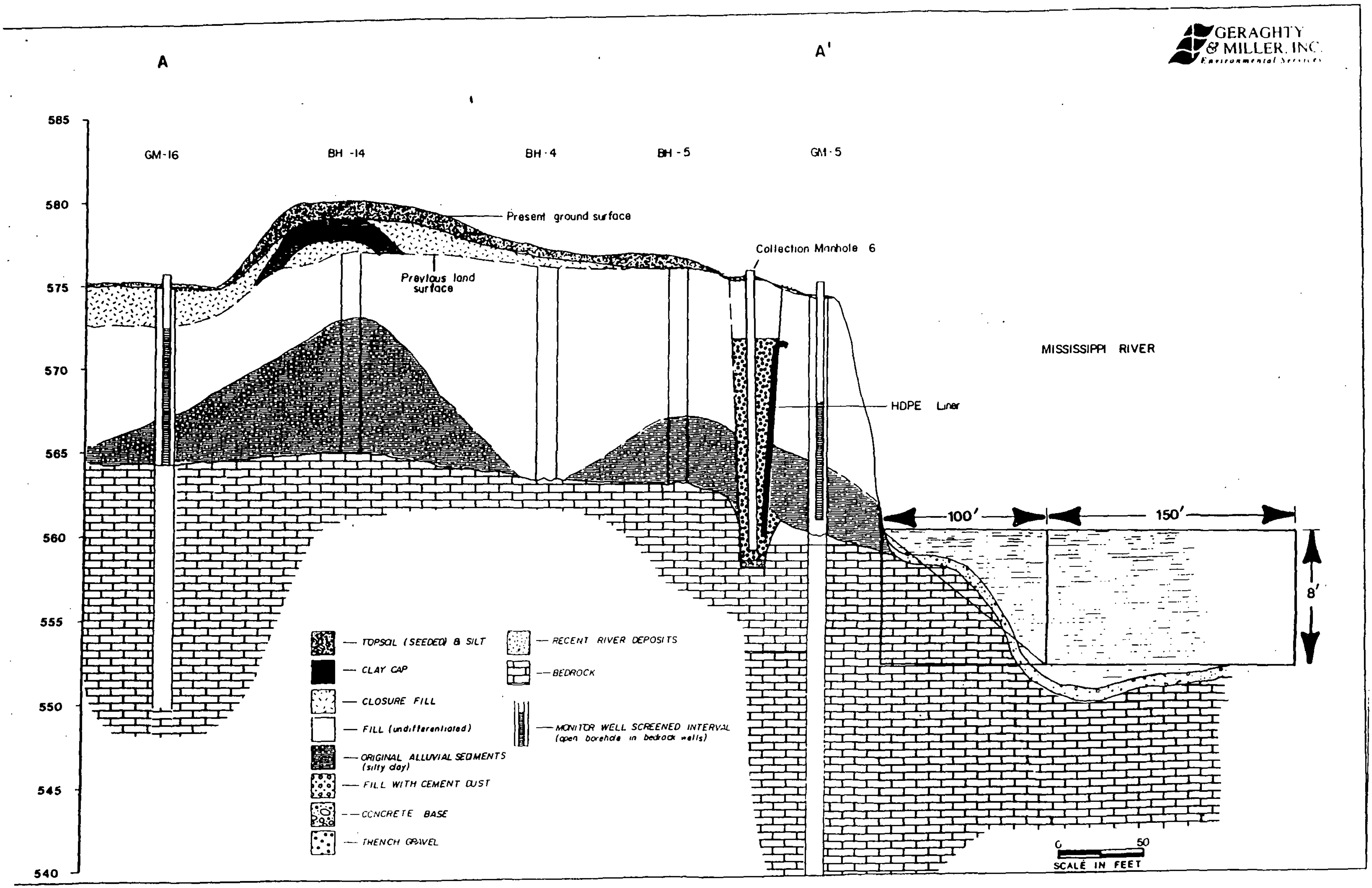
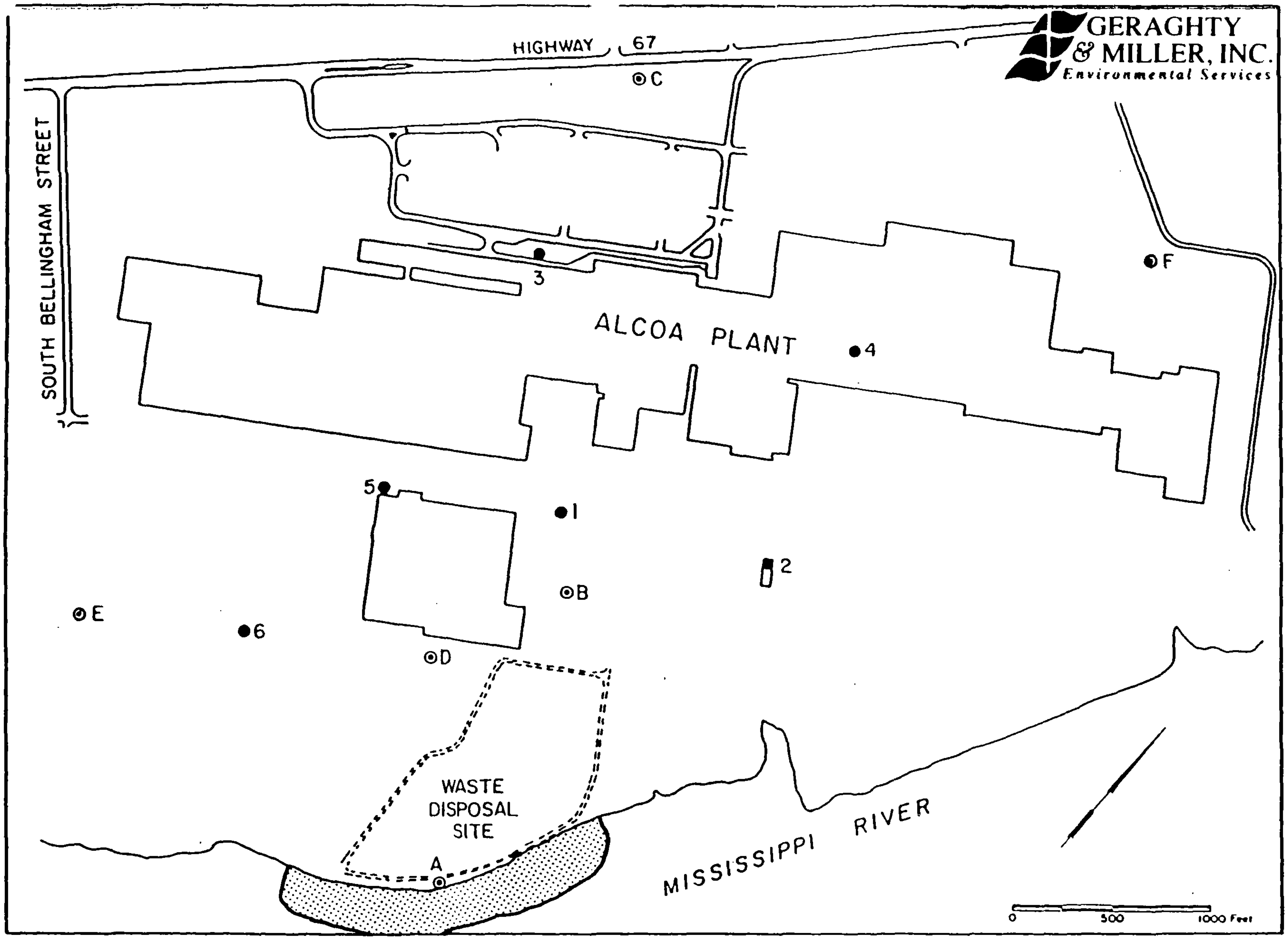


Figure 53. Configuration of the Cross-Sectional Area of the Mississippi River Within the Estimated Ground-Water Discharge Zone for the Alcoa-Davenport Waste Site.



EXPLANATION

● ALCOA PROCESS-WATER WELL

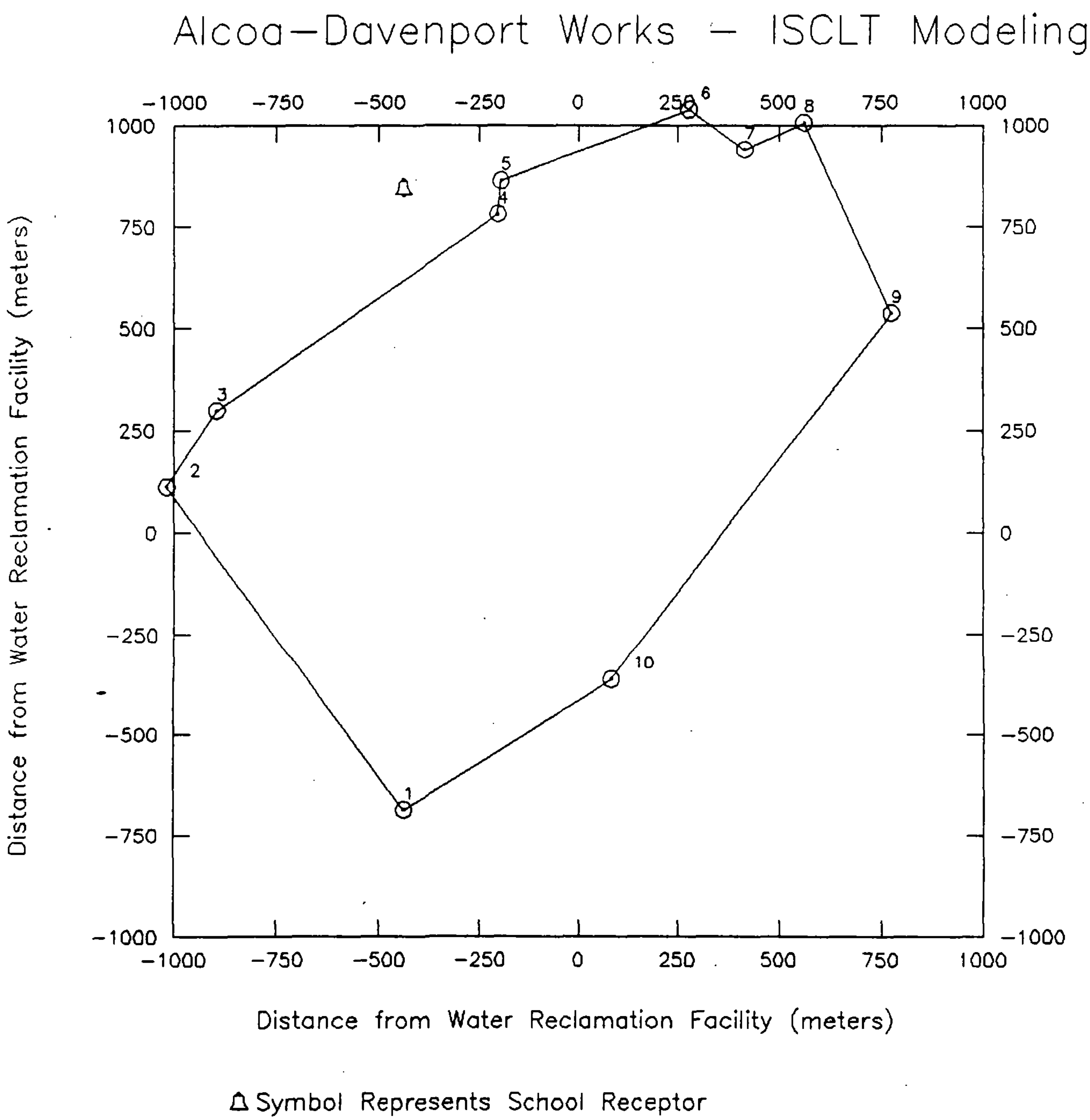
⊙ BEDROCK MONITOR WELL CLUSTER

DIMENSIONS OF DISCHARGE ZONE ESTIMATED FOR SEEPAGE FROM THE WASTE SITE.

Figure 54. Estimated Configuration of the Discharge Zone in the Mississippi River for Ground-Water Seepage from the Alcoa-Davenport Waste Site.

FIGURE 55

School Receptor and Ten Receptors at Plant Fenceline



TABLES

TABLE 1. DESCRIPTION OF KNOWN GROND-WATER WELLS LOCATED WITHIN APPROXIMATELY A ONE MILE RADIUS OF THE ALCOA-DAVENPORT WASTE SITE.

Designation From Fig. 13	Well Name/Owner	Address	Well Use	Well Depth	*Well Log Available?
A	Lowell Well	210 S. Bellingham	Drinking Water	Not Knwon (Probably Shallow Bedrock Well <100 feet)	No
B	Hargis Well	232 S. Bellingham	Drinking Water	Same as Above	No
C	Horsey Well	125 Kensington	Drinking Water	Same as Above	No
D	Showalter Well	123 Sycamore	Drinking Water	Same as Above	No
E	Dahms Well	127 Witeria	Drinking Water	Same as Above	No
F	Thomas Well	Listed in Quadrant Format on Well Log	Not Known (Probably Drinking/ Process Water)	95 feet	Yes
G	Kelly Cottage Well (Alcoa)	Unnamed Road Off of Bellingham Street	Drinking Water	Approx. 125 feet	No
H	Chrissey Well	Just North of Route 67 Across from Alcoa	Drinking Water	Not Known (Probably Shallow Bedrock Well <100 feet)	No
PW-1 through PW-6	Alcoa Davenport Plant	Highway 67 East	Process Water (Cooling)	400 to 415 feet	Yes
7	Meadows Transfer Company	Bellingham Street	Not Known (Processing, Possibly Potable Water Source)	250 feet	Yes
8	Iowana Dairy Company	Listed in Quadrant Format on Well Log	Not Known (Suspected Use is for Processing, Possibly Potable)	387 feet	Yes

TABLE 1.(CONTINUED) DESCRIPTION OF KNOWN GROND-WATER WELLS LOCATED WITHIN APPROXIMATELY A ONE MILE RADIUS OF THE ALCOA-DAVENPORT WASTE SITE.

Designation From Fig. 13	Well Name/Owner	Address	Well Use	Well Depth	*Well Log Available?
9	Case Harvester International	1100 Third Street	Non-Contact Cooling	400 feet	Yes
10	Foremost Packing Company	1164 13th Avenue	Not Used	104 feet	No
11	Foremost Packing Company	1164 13th Avenue	Processing and Drinking Water Source	260 feet	Yes

Note:

* Available Well Logs Provided in Appendix C.

TABLE 2

SUMMARY OF AUGUST 1982
PRIORITY POLLUTANT ANALYTICAL
RESULTS OF SAMPLES COLLECTED FROM THE
N-DRAIN AND PW-1 AT THE
ALCOA-DAVENPORT WASTE SITE

COMPOUNDS	Concentrations, ug/L		COMPOUNDS	Concentrations mg/L	
VOLATILE ORGANICS	PW-1	N-Drain	SWDA/RCRA PESTICIDES AND HERBICIDES	PW-1	N-Drain
1,2-Dichloroethene	85	13,000		No Compounds present above lab detection limits	
Vinyl Chloride	10	230			
1,1 Dichloroethene	--	36			
ACID EXTRACTABLE ORGANICS			RCRA METALS		
2,4 Dimethylphenol	90	--	Barium		1.0
Phenol	84	--	Chromium	0.18	0.14
			Lead		0.20
BASE NEUTRAL EXTRACTABLE ORGANICS	No Compounds present above lab detection limits		INORGANIC PRIORITY POLLUTANTS AND NUTRIENT CONCENTRATIONS		
			Cyanide, Total	.01	.01
			Phenols, Total	.61	.08
			COD	41.80	42.70
			TOC	406.00	287.00

TABLE 3
PCB ANALYTICAL RESULTS SUMMARY
TABLE FOR VARIOUS MEDIA AT THE
ALCOA-DAVENPORT WASTE SITE

MEDIUM	ALL CONCENTRATIONS REPORTED IN PPM (mg/l)		Mean Concentration	Standard Deviation
	Lowest Reported Concentration	Maximum Detected Concentration		
Oil Phase	0.003	15,000	6049.1	2101.5
Sediment Phase	ND	6,620	361.7	7121.2
Water Phase	ND	18	2.261	3.4
Water Phase[2] Dissolved PCB Solubility Range	0.018	0.054		

NOTES:
ND = Indicates Nondetection

1 = Mean PCB Concentrations for the Oil Phase Determined Utilizing Analytical Results from GM-6 Only. (Most Complete Set of Data, Provides Worst Case Concentrations).
Mean PCB Concentrations for the Sediment Phase Determined Utilizing Analytical Results from GM-7 Only. (Most Complete Set of Data, Provides Worst Case Concentrations).
Mean PCB Concentrations for the Water Phase Determined Utilizing Analytical Results from GM-6 Only. (Most Complete Set of Data, Provides Worst Case Concentrations).

2 = Represents the Maximum Concentration Range for Dissolved PCBs (Aroclor 1248) in Water
.018 ppm Value Determined in Site-Specific Solubility Study Using Oil and Water from Waste Site (Alcoa Technical Lab, 1988).
.054 ppm Represents 1979 Literature Value Recognized by the EPA (EPA-44014-79-0296).

TABLE 4
SUMMARY OF VOLATILE ORGANIC COMPOUNDS CONCENTRATIONS
IN GROUND-WATER SAMPLES COLLECTED FROM SELECTED
MONITOR WELLS AT THE ALCOA WASTE SITE

VOC CONSTITUENTS	DETEC-TION LIMIT	1986 OCTOBER	1987 APRIL	1987 OCTOBER	1988 MAY	1988 OCTOBER	1989[4] APRIL	AUGUST[5]	OCTOBER[10]	MEAN[9]	
GM-4											
Vinyl Chloride	10	---	---	---	---	---	---	NS		3.4	
1,2-Dichloroethene (total)	10	---	---	---	---	---	---			3.4	
1,1-Dichloroethene	10	---	---	---	---	---	---			3.4	
1,1-Dichloroethane	10	---	---	---	---	---	---			3.4	
Chloroethane	10	---	---	---	---	---	---			3.4	3.4
Trichloroethene	10	---	---	---	---	---	---			3.4	
1,1,1-Trichloroethane	10	---	---	---	---	---	---			3.4	
Toluene	10	---	---	---	---	---	---			3.4	
Cumulative VOCs		ND	ND	ND	ND	ND	ND	NS		ND	
GM-6											
Vinyl Chloride	10	---	---	---	---	NS	1.0	NS		3.4	
1,2-Dichloroethene (total)	10	(6.0)	(9.0)	13.0	10		10			9.6	
1,1-Dichloroethene	10	---	---	---	---		---			3.3	
1,1-Dichloroethane	10	---	---	---	---	(IW)	---			3.3	
Chloroethane	10	---	---	---	---		---			3.3	3.3
Trichloroethene	10	---	---	---	---		---			3.3	
1,1,1-Trichloroethane	10	---	---	---	---		---			3.3	
Toluene	10	(5.0)	---	---	---		1.0			3.6	
Cumulative VOCs		11.0[1]	9.0[1]	13.0	10	NS	12	NS		11.0	

...BLE 4 (CONTINUED)
SUMMARY OF VOLATILE ORGANIC COMPOUNDS CONCENTRATIONS
IN GROUND-WATER SAMPLES COLLECTED FROM SELECTED
MONITOR WELLS AT THE ALCOA WASTE SITE

VOC CONSTITUENTS	DETEC-TION LIMIT	1986 OCTOBER	1987 APRIL	1987 OCTOBER	1988 MAY	1988 OCTOBER	1989[6] APRIL	AUGUST	OCTOBER[10]	MEAN[9]	
GM-10											
Vinyl Chloride	10	30	18	(6)	20	NS	---	NS		14.9	
1,2-Dichloroethene (total)	10	120	53	11	46		---			46.1	
1,1-Dichloroethene	10	---	---	---	---		---			3.3	
1,1-Dichloroethane	10	---	---	---	---	(IW)	---			3.3	
Chloroethane	10	---	---	(5)	(6)		---			3.5	3.4
Trichloroethene	10	(5)	---	---	---		---			3.5	
1,1,1-Trichloroethane	10	---	---	---	---		---			3.3	
Toluene	10	---	---	---	---		---			3.3	
Cumulative VOCs		155[1]	71	22[1]	72[1]	NS	---	NS		64.0	
GM-12											
Vinyl Chloride	10	19	---	67	40	---	190	NS		54.0	
1,2-Dichloroethene (total)	10	40	---	150	77	(4)	570			140.8	
1,1-Dichloroethene	10	---	---	---	---	---	1.0			3.5	
1,1-Dichloroethane	10	---	---	---	---	---	1.0			3.5	
Chloroethane	10	---	---	---	---	---	---			3.4	3.5
Trichloroethene	10	---	---	---	---	---	---			3.4	
1,1,1-Trichloroethane	10	---	---	---	---	---	---			3.4	
Toluene	10	(7)	---	(7)	---	10	4			6.0	
Cumulative VOCs		66[1]	---	224[1]	117	14[1]	766	NS		197.8	

..BLE 4 (CONTINUED)
SUMMARY OF VOLATILE ORGANIC COMPOUNDS CONCENTRATIONS
IN GROUND-WATER SAMPLES COLLECTED FROM SELECTED
MONITOR WELLS AT THE ALCOA WASTE SITE

VOC CONSTITUENTS	DETEC-TION LIMIT	1986 OCTOBER	1987 APRIL	1987 OCTOBER	1988 MAY	1988 OCTOBER	1989[4] APRIL	AUGUST	OCTOBER[10]	MEAN[9]
AS										
Vinyl Chloride	10	---	---	---	---	---	---	NS		3.4
1,2-Dichloroethlene (total)	10	43	---	10	---	42	70			28.8
1,1-Dichloroethlene	10	---	---	---	---	---	---			3.4
1,1-Dichloroethlane	10	---	---	---	---	---	---			3.4
Chloroethane	10	---	---	---	---	---	---			3.4 3.4
Trichloroethene	10	---	---	---	---	---	---			3.4
1,1,1-Trichloroethane	10	---	---	---	---	---	---			3.4
Toluene	10	---	---	---	---	---	---			3.4
Cumulative VOCs		43	---	10	---	42	70	NS		27.5
GM-17										
Vinyl Chloride	10	NS	NS	NS	NS	NS	NS	10.0	NS	
1,2-Dichloroethlene (total)	10							77.0		
1,1-Dichloroethene	10							---		
1,1-Dichloroethane	10							22.0		
Chloroethane	10							16.0		
Trichloroethlene	10							---		
1,1,1-Trichloroethane	10							5.0		
Toluene	10							4.0		
Cumulative VOCs*		NS	NS	NS	NS	NS	NS	136	NS	

TABLE 4 (CONTINUED)
SUMMARY OF VOLATILE ORGANIC COMPOUNDS CONCENTRATIONS
IN GROUND-WATER SAMPLES COLLECTED FROM SELECTED
MONITOR WELLS AT THE ALCOA WASTE SITE

VOC CONSTITUENTS	DETEC-TION LIMIT	Pre-Trench 1982 AUGUST	1986 OCTOBER	1987 APRIL	1987 OCTOBER	1988 MAY	1988 OCTOBER	1989[4] APRIL	AUGUST	OCTOBER[10]	MEAN[9]
PW-1											
Vinyl Chloride	10	10	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-Dichloroethene (total)	10	85									
1,1-Dichloroethene	10	---									
1,1-Dichloroethane	10	---									
Chloroethane	10	---									
Trichloroethene	10	---									
1,1,1-Trichloroethane	10	---									
Toluene	10	---									
Cumulative VOCs		95	NS	NS	NS	NS	NS	NS	NS	NS	
N-DRAIN											
Vinyl Chloride		230	NS	NS	NS	NS	NS	NS	NS	NS	
1,2-Dichloroethene (total)		13,000									
1,1-Dichloroethene		36									
1.1-Dichloroethane		---									
Chloroethane		---									
Trichloroethene		---									
1,1,1-Trichloroethane		---									
Toluene		---									
Cumulative VOCs		13,266	NS	NS	NS	NS	NS	NS	NS	NS	

TABLE 4 (CONTINUED)
SUMMARY OF VOLATILE ORGANIC COMPOUNDS CONCENTRATIONS
IN GROUND-WATER SAMPLES COLLECTED FROM SELECTED
MONITOR WELLS AT THE ALCOA WASTE SITE

<u>NOTES:</u>

1. All Concentrations Reported In ppb.

2. --- Indicates That The Compound Was Not Detected Above Laboratory Detection Limits.

3. IW Indicates That Insufficient Water Was Present For Sampling.

4. Detection Limit Decreased By A Factor Of 10 For Wells GM-4, GM-6, GM-10 and GM-12 During April 1989 Only.

5. Detection Limit Decreased by a factor of 4 for well GM-17 during August 1989 only.

6. (5) Concentration Estimated by the Laboratory Since the Concentration is Less Than the Detection Limit but Equal to or Greater than 1/2 that Limit.

7. 155[1] Cumulative VOC Concentration Consists Partially or Entirely of Compounds whose Concentrations were Estimated by the lab (see Note 6).

8. Methylene Chloride Concentrations Excluded from Table because it is a Probable Lab Contaminant (Present in Numerous QA/QC Blanks).

9. Mean Values Calculated Using the Following Specifications:

   4.0 ug/L was substituted for Nondetection where Detection Limit is 10 ug/L;
   1.0 ug/L was substituted for Nondetection where Detection Limit is 2.5 ug/L;
   0.5 ug/L was substituted for Nondetection where Detection Limit is 1.0 ug/L; and

   Cumulative VOC Concentrations Calculated Using Individual Compound Concentrations Measured Above Lab Detection Limits Only (No Values Substituted for Nondetection)
   Mean Values Bracketed for Other VOCs

10. October Sampling Results not Included in Report.

TABLE 5.

RESULTS OF GROUND-WATER QUALITY ANALYSES OF SAMPLES FROM BEDROCK WELLS AT THE ALCOA-DAVENPORT PLANT. THESE RESULTS REPRESENT THE CONCENTRATIONS OF ONLY THOSE PRIORITY POLLUTANT COMPOUNDS THAT EXCEEDED THE DETECTION LIMITS; ALL OTHER COMPOUNDS WERE BELOW DETECTION LEVELS.

	Monitor Well													
Chemical Compound	AS* 3/85	AS* 12/85	AI 3/85	AI 12/85	AD 3/85	AD 12/85	BI 3/85	BI 12/85	BD 3/85	BD 12/85	CI 3/85	CI 12/85	CD 3/85	CD 12/85
<u>Volatile Organics</u> (ug/l)														
Vinyl chloride			19	53										
Methylene Chloride				12								10		
Trans-1,2,-Dichloroethylene			340	460			12	23	12					
Toluene						41								
Phenols (mg/l)		.042		.019				.049				.059		.012
<u>Base-Neutral Extractables (ug/l)</u>														
Benzo(A)Anthracene				11	12						11			
Chrysene				11	12						11			
Bis(2-ethylhexyl) Phthalate										10				11

Notes:

AS* - This well is completed into the waste-site aquifer, not the bedrock aquifer.

TABLE 6

SUMMARY TABLE OF ANALYTICAL DATA FOR
WATER SAMPLES COLLECTED FROM THE BEDROCK AQUIFER WELLS
AT THE ALCOA-DAVENPORT PLANT

VOLATILE ORGANIC COMPOUNDS	DETECTION LIMIT (ug/l)	1985		1986	1987		1988		1989		
		MARCH	DEC.	OCT.	APRIL	OCT.	MAY	OCT.	FEB.	APRIL	OCT.
WELL AI											
Vinyl Chloride	10	19	53	19	45		49	NS	NS		
1,2-Dichloroethene (total)[3]	10	340	460	150	65	55	37				
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs		359	513	169	110	55	86	NS	NS		
WELL AD											
Vinyl Chloride	10								NS		
1,2-Dichloroethene (total)	10										
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10		41								
Benzene	10			7E							
Ethylbenzene	10										
CUMULATIVE VOCs			41	7					NS		

TABLE 6 (CONTINUED)

SUMMARY TABLE OF ANALYTICAL DATA FOR
WATER SAMPLES COLLECTED FROM THE BEDROCK AQUIFER WELLS
AT THE ALCOA-DAVENPORT PLANT

VOLATILE ORGANIC COMPOUNDS	DETECTION LIMIT (ug/l)	1985		1986	1987		1988		1989		
		MARCH	DEC.	OCT.	APRIL	OCT.	MAY	OCT.	FEB.	APRIL	OCT.
<u>WELL BI</u>											
Vinyl Chloride	10							16	NS	75	
1,2-Dichloroethene (total)	10	12	23					6E		29	
1,1-Dichloroethane	10									6	
Trichloroethene	10									2	
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10									2	
Ethylbenzene	10										
CUMULATIVE VOCs		12	23	ND	ND	ND	ND	22	NS	114	
<u>WELL BD</u>											
Vinyl Chloride	10			5					NS		
1,2-Dichloroethene (total)	10	12		41	12	6E	8E	10		10	
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs		12	ND	46	12	6	8	10	NS	10	

TABLE 6 (CONTINUED)

SUMMARY TABLE OF ANALYTICAL DATA FOR
WATER SAMPLES COLLECTED FROM THE BEDROCK AQUIFER WELLS
AT THE ALCOA-DAVENPORT PLANT

VOLATILE ORGANIC COMPOUNDS	DETECTION LIMIT (ug/l)	1985		1986	1987		1988		1989		
		MARCH	DEC.	OCT.	APRIL	OCT.	MAY	OCT.	FEB.	APRIL	OCT.
WELL CI											
Vinyl Chloride	10								NS		
1,2-Dichloroethene (total)	10										
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs									NS		
WELL CD											
Vinyl Chloride	10								NS		
1,2-Dichloroethene (total)	10										
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs									NS		

TABLE 6 (CONTINUED)

SUMMARY TABLE OF ANALYTICAL DATA FOR
WATER SAMPLES COLLECTED FROM THE BEDROCK AQUIFER WELLS
AT THE ALCOA-DAVENPORT PLANT

VOLATILE ORGANIC COMPOUNDS	DETECTION LIMIT (ug/l)	1985		1986	1987		1988		1989		
		MARCH	DEC.	OCT.	APRIL	OCT.	MAY	OCT.	FEB.	APRIL	OCT.
WELL DS[1]											
Vinyl Chloride	10	NS	NS						NS		
1,2-Dichloroethene (total)	10			5^{E}	24		10	9^{E}			
1,1-Dichloroethane	10										
Trichloroethene	10				6^{E}						
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs		NS	NS	5	30		10	9^{E}	NS		
WELL DI[1]											
Vinyl Chloride	10	NS	NS	140	220	70	34	22	NS	300	
1,2-Dichloroethene (total)	10			410	480	53	35	16		530	
1,1-Dichloroethane	10			79	92	45	80	52		76	
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10									6^{E}	
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs		NS	NS	629	792	168	149	90	NS	912	

TABLE 6 (CONTINUED)

SUMMARY TABLE OF ANALYTICAL DATA FOR
WATER SAMPLES COLLECTED FROM THE BEDROCK AQUIFER WELLS
AT THE ALCOA-DAVENPORT PLANT

VOLATILE ORGANIC COMPOUNDS	DETECTION LIMIT (ug/l)	1985		1986	1987		1988		1989		
		MARCH	DEC.	OCT.	APRIL	OCT.	MAY	OCT.	FEB.	APRIL	OCT.
<u>WELL DD</u>[1]											
Vinyl Chloride	10	NS	NS	59	31	22	11	100	NS	220	
1,2-Dichloroethene (total)	10			23	82	46	43	180		480	
1,1-Dichloroethane	10			43	32	29	53	39		38	
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs		NS	NS	125	145	97	107	319	NS	738	
<u>WELL ES</u>[2]											
Vinyl Chloride	10	NS	NS	NS	NS	NS	NS	NS			
1,2-Dichloroethene (total)	10										
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs		NS	NS	NS	NS	NS	NS	NS			

TABLE 6 (CONTINUED)

SUMMARY TABLE OF ANALYTICAL DATA FOR
WATER SAMPLES COLLECTED FROM THE BEDROCK AQUIFER WELLS
AT THE ALCOA-DAVENPORT PLANT

VOLATILE ORGANIC COMPOUNDS	DETECTION LIMIT (ug/l)	1985		1986	1987		1988		1989		
		MARCH	DEC.	OCT.	APRIL	OCT.	MAY	OCT.	FEB.	APRIL	OCT.
WELL EI[2]											
Vinyl Chloride	10	NS	NS	NS	NS	NS	NS	NS			
1,2-Dichloroethene (total)	10										
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10								12	18	
Benzene	10								1370	1500	
Ethylbenzene	10									11	
CUMULATIVE VOCs		NS	NS	NS	NS	NS	NS	NS	1382	1529	
WELL ED[2]											
Vinyl Chloride	10	NS	NS	NS	NS	NS	NS	NS			
1,2-Dichloroethene (total)	10										
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs		NS	NS	NS	NS	NS	NS	NS			

TABLE 6 (CONTINUED)

SUMMARY TABLE OF ANALYTICAL DATA FOR
WATER SAMPLES COLLECTED FROM THE BEDROCK AQUIFER WELLS
AT THE ALCOA-DAVENPORT PLANT

VOLATILE ORGANIC COMPOUNDS	DETECTION LIMIT (ug/l)	1985		1986	1987		1988		1989		
		MARCH	DEC.	OCT.	APRIL	OCT.	MAY	OCT.	FEB.	APRIL	OCT.
WELL FS[2]											
Vinyl Chloride	10	NS	NS	NS	NS	NS	NS	NS			
1,2-Dichloroethene (total)[3]	10										
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMUALTIVE VOCs		NS	NS	NS	NS	NS	NS	NS			
WELL FI[2]											
Vinyl Chloride	10	NS	NS	NS	NS	NS	NS	NS			
1,2-Dichloroethene (total)[3]	10										
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs		NS	NS	NS	NS	NS	NS	NS			

TABLE 6 (CONTINUED)

SUMMARY TABLE OF ANALYTICAL DATA FOR
WATER SAMPLES COLLECTED FROM THE BEDROCK AQUIFER WELLS
AT THE ALCOA-DAVENPORT PLANT

VOLATILE ORGANIC COMPOUNDS	DETECTION LIMIT (ug/l)	1985		1986	1987		1988		1989		
		MARCH	DEC.	OCT.	APRIL	OCT.	MAY	OCT.	FEB.	APRIL	OCT.
WELL FD[2]											
Vinyl Chloride	10	NS	NS	NS	NS	NS	NS	NS			
1,2-Dichloroethene (total)[3]	10										
1,1-Dichloroethane	10										
Trichloroethene	10										
Tetrachloroethene	10										
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10										
Ethylbenzene	10										
CUMULATIVE VOCs		NS	NS	NS	NS	NS	NS	NS			
WELL PW-6											
Vinyl Chloride	10	NS	NS	NS	NS	NS	27	250	NS	210	
1,2-Dichloroethene (total)	10						84	560		550	
1,1-Dichloroethane	10						11	46		48	
Trichloroethene	10						13	160		420	
Tetrachloroethene	10						7[E]	430		540	
1,1,1-Trichloroethane	10										
Toluene	10										
Benzene	10						12	19		16	
Ethylbenzene	10										
CUMULATIVE VOCs		NS	NS	NS	NS	NS	147[5]	1035[5]	NS	1244[5]	

NOTES:

Spaces left blank indicate non-detection, except for October 1989, for which time analytical results have not yet been compiled.

1 - Wells installed in October 1986. 2 - Well installed in January 1989.

3 - Previously referred to as: trans 1,2 Dichloroethylene or cis 1,2 Dichloroethylene.

4 - Detection limit for April, 1989 sampling event = 1.0 ppb.

5 - Cumulative VOC concentrations do not include tetrachloroethene concentrations, since this compound is a non waste-site VOC.

NS - Not Sampled

E - Estimated concentration: Below laboratory detection limit.

TABLE 7

BEDROCK WELL CLUSTER A SUMMARY STATISTICS

Variable:	Intermediate	Deep
Sample size	7	8
Average	184.579	8.50625
Median	110	4
Mode	86	4
Geometric mean	50.2561	3.31813
Variance	34107.9	175.879
Standard deviation	184.683	13.2619
Standard error	69.8037	4.6888
Minimum	0.05	0.05
Maximum	513	41
Range	512.95	40.95
Lower quartile	55	4
Upper quartile	359	5.5
Interquartile range	304	1.5
Skewness	1.1444	2.71467
Standardized skewness	1.23609	3.13463
Kurtosis	0.266633	7.53579
Standardized kurtosis	0.143998	4.35079
Coefficient of variation	1.0	1.56

TABLE 8

BEDROCK WELL CLUSTER B SUMMARY STATISTICS

Variable:	Intermediate	Deep
Sample size	8	8
Average	23.375	13.5
Median	8	10
Mode	4	12
Geometric mean	10.7414	10.3051
Variance	1406.55	180.286
Standard deviation	37.504	13.4271
Standard error	13.2597	4.74718
Minimum	4	4
Maximum	114	46
Range	110	42
Lower quartile	4	7
Upper quartile	22.5	12
Interquartile range	18.5	5
Skewness	2.57714	2.58012
Standardized skewness	2.97582	2.97927
Kurtosis	6.89	7.0008
Standardized kurtosis	3.97794	4.04191
Coefficient of variation	1.60	0.99

TABLE 9

BEDROCK WELL CLUSTER C SUMMARY STATISTICS

Variable:	Intermediate	Deep
Sample size	8	8
Average	3.50625	3.50625
Median	4	4
Mode	4	4
Geometric mean	2.31299	2.31299
Variance	1.95031	1.95031
Standard deviation	1.39654	1.39654
Standard error	0.49375	0.49375
Minimum	0.05	0.05
Maximum	4	4
Range	3.95	3.95
Lower quartile	4	4
Upper quartile	4	4
Interquartile range	0	0
Skewness	-2.82843	-2.82843
Standardized skewness	-3.26599	-3.26599
Kurtosis	8	8
Standardized kurtosis	4.6188	4.6188
Coefficient of variation	0.40	0.40

TABLE 10

BEDROCK WELL CLUSTER D SUMMARY STATISTICS

Variable:	Shallow	Intermediate	Deep
Sample size	6	6	6
Average	9.675	456.667	255.167
Median	7	398.5	135
Mode	4	149	107
Geometric mean	3.73159	317.457	188.096
Variance	112.074	132381	62650.6
Standard deviation	10.5865	363.843	250.301
Standard error	4.32192	148.538	102.185
Minimum	0.05	90	97
Maximum	30	912	738
Range	29.95	822	641
Lower quartile	4	149	107
Upper quartile	10	792	319
Interquartile range	6	643	212
Skewness	1.82546	0.216474	1.95268
Standardized skewness	1.82546	0.216474	1.95268
Kurtosis	3.82343	-2.63549	3.72052
Standardized kurtosis	1.91171	-1.31775	1.86026
Coefficient of variation	1.09	0.80	0.98

TABLE 11

BEDROCK WELL CLUSTER E SUMMARY STATISTICS

Variable:	Shallow	Intermediate	Deep
Sample size	2	2	2
Average	2.025	1455.5	2.025
Median	2.025	1455.5	2.025
Mode	4	1529	4
Geometric mean	0.447214	1453.64	0.447214
Variance	7.80125	10804.5	7.80125
Standard deviation	2.79307	103.945	2.79307
Standard error	1.975	73.5	1.975
Minimum	0.05	1382	0.05
Maximum	4	1529	4
Range	3.95	147	3.95
Lower quartile	0.05	1382	0.05
Upper quartile	4	1529	4
Interquartile range	3.95	147	3.95
Skewness	0	0	0
Standardized skewness	0	0	0
Kurtosis	0	0	0
Standardized kurtosis	0	0	0
Coefficient of variation	1.38	0.07	1.38

TABLE 12

BEDROCK WELL CLUSTER F SUMMARY STATISTICS

Variable:	Shallow	Intermediate	Deep
Sample size	2	2	2
Average	2.025	2.025	2.025
Median	2.025	2.025	2.025
Mode	4	4	4
Geometric mean	0.447214	0.447214	0.447214
Variance	7.80125	7.80125	7.80125
Standard deviation	2.79307	2.79307	2.79307
Standard error	1.975	1.975	1.975
Minimum	0.05	0.05	0.05
Maximum	4	4	4
Range	3.95	3.95	3.95
Lower quartile	0.05	0.05	0.05
Upper quartile	4	4	4
Interquartile range	3.95	3.95	3.95
Skewness	0	0	0
Standardized skewness	0	0	0
Kurtosis	0	0	0
Standardized kurtosis	0	0	0
Coefficient of variation	1.37	1.37	1.37

TABLE 13

BEDROCK WELL DI REGRESSION ANALYSIS RESULTS DATA

Regression Analysis - Linear model: Y = a+bX

Dependent variable: DWELL.intermed (Total VOC's) Independent variable: DWELL.date

Parameter	Estimate	Standard Error	T Value	Prob. Level
Intercept	2207.97	7299.73	0.302472	.77737
Slope	-0.126134	0.525613	-0.239974	.82215

Analysis of Variance

Source	Sum of Squares	Df	Mean Square	F-Ratio	Prob. Level
Model	9394.1727	1	9394.1727	.058	.82215
Error	652513.16	4	163128.29		
Total (Corr.)	661907.33	5			

Correlation Coefficient = -0.119133 R-squared = 1.42 percent
Stnd. Error of Est. = 403.891

TABLE 14
SUMMARY TABLE
FOR ANALYTICAL RESULTS FROM
MISSISSIPPI RIVER WATER SAMPLES, APRIL AND AUGUST, 1989

COMPOUNDS	SAMPLE NUMBER										
VOCs - 624* Constituents	Detection Limit ug/L	MR-1		MR-2		MR-3		MB-4 (Field Blank)		Lab Instrument Blank	
		4/89	8/89	4/89	8/89	4/89	8/89	4/89	8/89	4/89	8/89
Toluene	1.0	--	--	--	--	--	--	1.0	--	--	--
Chloroform	1.0	4.0	2.0	4.0	--	--	--	--	--	--	--
Methylene Chloride	1.0	--	2.0	--	2.0	1.0	2.0	3.0	2.0	2.0	--
Tetrachloroethene	1.0	--	1.0	--	3.0	--	--	--	--	--	--
PCBS											
1242	1.0	--	--	--	--	--	--	--	--	--	--
1254	1.0	--	--	--	--	--	--	--	--	--	--
1221	1.0	--	--	--	--	--	--	--	--	--	--
1232	1.0	--	--	--	--	--	--	--	--	--	--
1248	1.0	--	--	--	--	--	--	--	--	--	--
1260	1.0	--	--	--	--	--	--	--	--	--	--
1016	1.0	--	--	--	--	--	--	--	--	--	--

*Complete 624 Priority Pollutant VOC Scan Performed on Each Sample; Only Those Compounds Present Above Lab Detection Limits Included on Table.

-- Compound Not Present Above Laboratory Detection Limit.

MB-4 - Blind Field Blank Collected Prior to Collecting Mississippi River Water Samples.

Lab Instrument Blank - Analysis Performed by Laboratory for Quality Control Purposes to Determine Extent of Lab Conntamination.

Methylene Chloride - Suspected Lab Contaminant (Present in Field Blank).

TABLE 15

AREA OF ELEMENTS USED IN VERTICAL FLUX CALCULATIONS AT THE ALCOA-DAVENPORT WASTE SITE.

Vertical Flux Polygonal Element ID	Element Area (ft^2)
Va	91,187
Vb	113,482
Vc	161,357
Vd	184,493
Ve	124,178
Vf	69,472
Vg	80,125
Vh	38,327
Vi	127,569
TOTAL AREA	990,194

TABLE 16

LENGTH OF ELEMENTS USED IN HORIZONTAL
FLUX CALCULATIONS BENEATH THE HDPE LINER
AT THE ALCOA-DAVENPORT WASTE SITE

Horizontal Flux Curvilinear Element ID	Element Length (ft)
HDPE 1	560
HDPE 2	524
HDPE 3	428
HDPE 4	657
TOTAL LENGTH	2,170

TABLE 17

TABLE OF HYDRAULIC PROPERTIES OF
SATURATED FORMATION BENEATH
WASTE DISPOSAL SITE BASED
UPON SLUG TEST RESULTS

WELL	HYDRAULIC CONDUCTIVITY		AQUIFER* THICKNESS			TRANSMISSIVITY	
	FT/MIN	GAL/DAY/FT^2	TOTAL (FT)	UNCON-SOLIDATED	BEDROCK (FT)	FT^2/MIN	GAL/DAY/FT
GM-4	2.67×10^{-3}	28.84	5.6	3.70	1.90	1.49×10^{-3}	161.50
GM-6	6.58×10^{-3}	70.84	4.6	1.60	3.00	3.03×10^{-2}	325.86
AS	1.00×10^{-3}	10.77	3.7	3.7	0	3.7×10^{-3}	39.85
GM-12	2.97×10^{-3}	32.03	3.5	3.5	0	1.04×10^{-2}	112.10
GM-14	1.45×10^{-2}	156.32	2.5	2.5	0	7.27×10^{-2}	390.80
GM-16	3.91×10^{-4}	4.22	11.0	2.00	9.00	4.30×10^{-3}	46.42

NOTES: Aquifer thickness comprised of unconsolidated and bedrock lithology, thus, the calculated K & T values represent a composite of the hydraulic properties for these two media.

TABLE 18

PRECIPITATION DATA FROM NATIONAL WEATHER SERVICE BUREAU AT MOLINE AIRPORT FOR 1987

DAY	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
	MONTH											
1	.28	0	.18	T	0	.20	0	0	0	0	.61	Tr
2	Tr	0	0	0	.23	Tr	0	0	0	0	.01	Tr
3	0	0	0	0	Tr	0	0	.09	0	0	0	.02
4	0	0	0	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	.15	0	0	Tr	0	0
6	Tr	0	0	0	0	0	.20	0	.10	.02	Tr	.28
7	0	0	0	0	0	0	Tr	0	.19	0	.09	.10
8	Tr	0	0	0	0	0	.11	2.03	0	0	Tr	.18
9	.29	0	Tr	0	0	0	0	0	0	Tr	Tr	.04
10	.01	0	0	Tr	0	.02	.03	Tr	Tr	.02	0	0
11	0	0	0	Tr	0	.04	0	0	0	0	0	.03
12	0	0	.11	0	0	0	Tr	0	.07	0	0	0
13	0	Tr	.02	.63	0	0	.02	.73	Tr	0	0	0
14	0	.03	.32	.12	0	0	.72	1.36	0	Tr	0	.22
15	0	0	.19	0	0	0	.11	.16	.03	Tr	.02	.90
16	0	0	0	Tr	0	0	0	.71	.29	.09	.78	Tr
17	.10	0	0	0	Tr	0	0	0	.08	0	.22	0
18	Tr	0	.23	0	0	0	Tr	Tr	Tr	.02	.01	Tr
19	0	0	Tr	0	Tr	.02	0	0	Tr	.09	0	1.39
20	0	0	0	0	2.15	.14	0	.08	Tr	.03	0	.18
21	Tr	.04	0	.46	.03	0	Tr	3.55	.04	0	0	0
22	Tr	0	0	.04	0	0	0	.02	0	0	.05	0
23	0	0	.05	.01	0	0	0	0	0	.21	0	Tr
24	0	0	.56	0	Tr	0	Tr	.02	0	.08	.34	.04
25	0	0	.19	0	.16	.80	0	3.38	0	0	.05	0
26	0	0	Tr	.19	0	0	0	3.05	0	.05	Tr	0
27	.07	Tr	.01	0	.37	0	.18	.05	0	0	.26	.66
28	Tr	.82	.69	0	0	0	Tr	Tr	.31	0	.77	.42
29	.16		.02	0	Tr	.24	.39	0	0	0	.12	Tr
30	Tr		0	0	Tr	.08	Tr	0	0	0	Tr	Tr
31	Tr		0		.38		0	0		.18		Tr
Monthly Total	.91	.89	2.57	1.49	3.35	1.54	1.91	15.23	1.11	.79	3.33	4.46
Monthly Normal	1.64	1.30	2.77	3.97	4.21	4.32	4.88	3.76	3.74	2.70	1.96	1.92
Departure From Normal	-.73	-.41	-.20	-2.48	-.86	-2.78	-2.97	+11.47	-2.63	-1.91	+1.37	+2.54

All precipitation data reported in inches of water.
Tr = Trace amount.

TABLE 19

PRECIPITATION DATA FROM THE NATIONAL WEATHER
SERVICE BUREAU AT MOLINE AIRPORT FOR 1988.

DAY	MONTH JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
1	0	0.09	0	0	0	0	0	0	0	0.70	0	TR
2	0	TR	0	0.27	0	0	TR	0	0	0.05	0	0
3	TR	0.13	0	0.32	0	0	0	0	0.03	TR	0	0
4	TR	0.01	0	0	0	0	0	0.29	0.01	0	0.27	0
5	0	0	0	0.02	0.75	0	0	0	0	0	0.06	0
6	0	0	0	0.34	0	0	0	0	0	0	TR	0
7	0	0	TR	0	0	0	0	0	0	0	0.04	0
8	0	0.07	TR	0	0	0.38	0	0.59	0	0	0	0
9	TR	0.01	0	0	0.03	0	0	0.03	0	0	0.37	0
10	0	0.51	0	TR	0	0	0.24	0.36	0	0	TR	0
11	0	0.03	0.03	0	0.24	0	0	0	0	0	0	0
12	TR	TR	TR	0	0.10	0	0	0	0	0	0.78	0.01
13	0	TR	TR	0.01	TR	0	0	TR	0	0	0	0
14	TR	0.24	TR	0	0	0	0.29	0	0	TR	0	0
15	0	0.01	TR	0	0.04	0	0	0	0	0	0.34	0
16	0	0.01	0	0	0	0	TR	0	0.12	0.01	0	TR
17	0.21	0	TR	0	0	0	TR	0	TR	0.57	0	TR
18	0	0	0	0	0	TR	TR	0.17	1.18	0.01	0.03	0
19	1.02	TR	TR	0	0	0	0.02	0.01	0.21	0	0.17	0
20	0.01	TR	0	0.01	0	0	0	0	0	0.40	TR	0.09
21	TR	TR	0	0.23	0	0	0	0	0	0.01	0	0
22	TR	0	0	TR	0.02	TR	0	1.77	TR	0.49	0	0.36
23	0.09	TR	TR	TR	1.14	0	0	TR	0	0.13	0	0
24	0.06	0	1.13	0	0	0.22	0	0	0	0	0	0.05
25	0.05	0	0.05	0.06	0	0	0	0	0	0	0.15	0
26	0	0	TR	0.10	0	0	0	0.02	0	0	0.90	0.37
27	TR	0	0	TR	0	0	0	1.65	0.05	TR	TR	0.69
28	0	0	0.91	0	0	0	0	0	0.34	0	0.03	TR
29	0	0	0.23	0	0	0.56	0.68	0	0	0	0	0
30	0		0	0	0	0	0	TR	0.03	0	TR	0
31	0.30		0		0		0	0		0		0
Monthly Total	1.74	1.08	2.36	1.36	2.32	1.16	1.79	4.89	1.97	2.37	3.14	1.57
Monthly Normal	1.64	1.30	2.77	3.97	4.21	4.32	4.88	3.76	3.74	2.70	1.96	1.92
Departure From Normal	+0.10	-0.22	-0.41	-2.61	-1.89	-3.16	-3.09	+1.33	-1.77	-0.33	+1.18	-0.35

All precipitation data reported in inches of water.
TR - Trace amount.

TABLE 20

VERTICAL FLUX CALCULATIONS FOR
MEAN ANNUAL CONDITIONS AT THE
ALCOA-DAVENPORT WASTE SITE

Vertical Flux Polygonal Element ID	Vertical Head Difference (ft)		Vertical Flux[1] (gal/day)	
	1987	1988	1987	1988
Va	27	33	1230	1509
Vb	36	38	2080	2201
Vc	25	31	2048	2531
Vd	20	27	1912	2566
Ve	33	40	2091	2520
Vf	20	27	709	952
Vg	22	29	879	1178
Vh	22	30	435	575
Vi	24	31	1551	2000
		TOTAL FLUX	12,939	16,036

[1] Assumes a vertical hydraulic conductivity of 0.004 ft/day and a uniform 60-ft thick confining unit.

	TOTAL FLUX Q (gal/day)	PRECIPITATION RECHARGE (gal/day)
1987	12,939	17,317
1988	16,036	12,674

TABLE 21

VERTICAL FLUX CALCULATIONS FOR
MEAN NONPUMPING AND PUMPING CONDITIONS
AT THE ALCOA-DAVENPORT WASTE SITE

Nonpumping Conditions

Vertical Flux Polygonal Element ID	Vertical Head Difference (ft) 1987	1988	Vertical Flux[1] (gal/day) 1987	1988
Va	3	4	140	173
Vb	19	11	1113	631
Vc	1	3	88	217
Vd	1	2	144	162
Ve	13	14	859	858
Vf	1	1	23	9
Vg	2	2	95	78
Vh	2	1	40	30
Vi	-0.01	-0.2	-1	-11
		TOTAL FLUX	2,504	2,147

Pumping Conditions

Vertical Flux Polygonal Element ID	Vertical Head Difference (ft) 1987	1988	Vertical Flux[1] (gal/day) 1987	1988
Va	63	68	2872	3081
Vb	73	72	4123	4069
Vc	62	67	4953	5363
Vd	48	49	4383	4531
Ve	60	62	3736	3851
Vf	47	49	1640	1706
Vg	47	52	1895	2064
Vh	50	53	951	1015
Vi	56	59	3546	3755
		TOTAL FLUX	28,100	29,437

[1] Assumes a vertical hydraulic conductivity of 0.004 ft/day and a uniform 60-ft thick confining unit.

TABLE 22

HORIZONTAL FLUX CALCULATIONS
FOR MEAN ANNUAL CONDITIONS
AT THE ALCOA-DAVENPORT WASTE SITE

Horizontal Flux Curvilinear Element ID	Hydraulic Gradient 1987	Hydraulic Gradient 1988	Horizontal Flux[1] (gal/day) 1987	Horizontal Flux[1] (gal/day) 1988
HDPE 1	0.012	0.006	231	114
HDPE 2	0.008	0.009	149	172
HDPE 3	0.013	0.011	192	168
HDPE 4	0.041	0.016	967	379
		TOTAL FLUX	1540	833

[1] Assumes a horizontal hydraulic conductivity of 4.76 ft/day and a uniform thickness of 1 ft.

TABLE 23

SENSITIVITY ANALYSIS ON VERTICAL
FLUX CALCULATIONS FOR
MEAN ANNUAL CONDITIONS
AT THE ALCOA-DAVENPORT WASTE SITE

Vertical Flux Polygonal Element ID	Vertical Flux[1] (gal/day) 1987	Vertical Flux[1] (gal/day) 1988	Vertical Flux[2] (gal/day) 1987	Vertical Flux[2] (gal/day) 1988
Va	164	202	1846	2265
Vb	278	294	3120	3302
Vc	274	339	3073	3797
Vd	256	343	2869	3850
Ve	280	337	3138	3780
Vf	95	127	1064	1429
Vg	118	158	1319	1768
Vh	59	77	654	863
Vi	208	268	2327	3001
TOTAL FLUX	1,731	2,145	19,409	24,055

[1] Assumes a vertical hydraulic conductivity of 5.35e-4 ft/day and a uniform 60-ft thick confining unit.

[2] Assumes a vertical hydraulic conductivity of 0.006 ft/day and a uniform 60-ft thick confining unit.

TABLE 24

SENSITIVITY ANALYSIS ON VERTICAL
FLUX CALCULATIONS FOR
MEAN NONPUMPING CONDITIONS
AT THE ALCOA-DAVENPORT WASTE SITE

Vertical Flux Polygonal Element ID	Vertical Flux[1] (gal/day) 1987	1988	Vertical Flux[2] (gal/day) 1987	1988
Va	19	23	211	259
Vb	149	84	1671	946
Vc	12	29	133	326
Vd	19	22	217	243
Ve	115	115	1288	1287
Vf	3	1	35	14
Vg	13	11	142	117
Vh	5	4	60	45
Vi	-0.1	-2	-1	-17
TOTAL FLUX	335	287	3,755	3,220

[1] Assumes a vertical hydraulic conductivity of 5.35e-4 ft/day and a uniform 60-ft thick confining unit.

[2] Assumes a vertical hydraulic conductivity of 0.006 ft/day and a uniform 60-ft thick confining unit.

TABLE 25

SENSITIVITY ANALYSIS ON VERTICAL FLUX CALCULATIONS FOR MEAN PUMPING CONDITIONS AT THE ALCOA-DAVENPORT WASTE SITE

Vertical Flux Polygonal Element ID	Vertical Flux[1] (gal/day)		Vertical Flux[2] (gal/day)	
	1987	1988	1987	1988
Va	384	412	4308	4622
Vb	551	544	6185	6104
Vc	663	717	7430	8046
Vd	586	606	6574	6797
Ve	500	515	5605	5777
Vf	219	228	2460	2559
Vg	254	276	2843	3096
Vh	127	136	1427	1523
Vi	474	502	5320	5633
TOTAL FLUX	3,759	3,937	42,151	44,156

[1] Assumes a vertical hydraulic conductivity of 5.35e-4 ft/day and a uniform 60-ft thick confining unit.

[2] Assumes a vertical hydraulic conductivity of 0.006 ft/day and a uniform 60-ft thick confining unit.

TABLE 26
HYDRAULIC HEADS AND GRADIENTS IN BEDROCK AQUIFER
ADJACENT TO THE MISSISSIPPI RIVER FOR
1987 AND 1988

1987

	MEASUREMENT LOCATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
MEAN HYDRAULIC HEADS (FT MSL)	A Cluster	555.36	559.09	562.06	562.54	562.15	539.92	526.39	519.33*	516.33*	512.41	533.61	542.23
	D Cluster	554.25	559.34	562.86	563.35	561.67	537.75	523.53	511.78	506.84	505.44	529.99	540.99
	Miss River	561.78	561.58	561.88	561.87	561.33	561.32	561.16	561.44	560.83	560.83	562.18	562.30
HEAD DIFFERENCE (FT)	A to D	-1.11	0.25	0.80	0.81	-0.48	-2.17	-2.86	-7.59	-9.49	-6.97	-3.62	-1.24
	Miss River to A Cluster	-6.42	-2.49	0.18	0.67	0.82	-21.40	-34.77	-42.07	-44.5	-48.42	-28.57	-20.07
HYDRAULIC GRADIENTS	A to D	-1.11×10^{-3}	2.5×10^{-4}	8.0×10^{-4}	8.10×10^{-4}	-4.8×10^{-4}	-2.17×10^{-3}	-2.86×10^{-3}	-7.59×10^{-3}	-9.49×10^{-3}	-6.97×10^{-3}	-3.62×10^{-3}	-1.24×10^{-3}
	Miss River to A Cluster	-1.28×10^{-2}	-4.98×10^{-3}	3.64×10^{-4}	1.34×10^{-3}	1.64×10^{-3}	-4.28×10^{-2}	-8.95×10^{-2}	-8.41×10^{-2}	-8.90×10^{-2}	-9.68×10^{-2}	-5.72×10^{-2}	-4.01×10^{-2}

1988

	MEASUREMENT LOCATION	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
MEAN HYDRAULIC HEADS (FT MSL)	A Cluster	552.41	560.89	562.92	562.85	545.30	531.37	516.76	513.82	512.33	513.78	515.13	NM
	D Cluster	551.14	561.89	563.63	563.59	544.88	525.91	511.73	502.70	505.74	507.89	510.93	NM
	Miss River	562.38	561.88	562.50	562.56	561.55	561.36	560.98	560.96	561.18	561.18	560.98	561.60
HEAD DIFFERENCE	A to D	-1.27	1.00	0.71	0.74	-0.42	-5.46	-5.03	-11.12	-7.00	-5.89	-4.2	
	Miss River to A Cluster	-9.97	-.99	0.42	0.29	-16.25	-29.99	-44.24	-47.14	-48.85	-47.40	-45.85	
HYDRAULIC GRADIENTS	A to D	-1.27×10^{-3}	1.00×10^{-3}	7.1×10^{-4}	7.4×10^{-4}	-4.2×10^{-4}	-5.46×10^{-3}	-5.03×10^{-3}	-1.11×10^{-2}	-7.0×10^{-3}	-5.89×10^{-3}	-4.2×10^{-3}	
	Miss River to A Cluster	-1.99×10^{-2}	-1.98×10^{-3}	8.4×10^{-4}	5.8×10^{-4}	-3.25×10^{-2}	6.0×10^{-2}	8.84×10^{-2}	-9.43×10^{-2}	-9.77×10^{-2}	-9.48×10^{-2}	-9.17×10^{-2}	

TABLE 27
ESTIMATION OF GROUND-WATER FLUX RATES BETWEEN THE
BEDROCK AQUIFER AND THE MISSISSIPPI RIVER AT THE
ALCOA-DAVENPORT PLANT DURING 1987 AND 1988

1987	K (GPD/FT^2)	A (FT^2)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
HYDRAULIC GRADIENT			-1.11×10^{-3}	2.5×10^{-4}	8.0×10^{-4}	8.1×10^{-4}	-4.8×10^{-4}	-2.17×10^{-3}	-2.86×10^{-3}	-7.59×10^{-3}	-9.49×10^{-3}	-6.97×10^{-3}	-3.62×10^{-3}	-1.24×10^{-3}
I	35	8.52×10^5	-3.31×10^4	**7.46×10^3**	**2.39×10^4**	**2.42×10^4**	-1.43×10^4	-6.47×10^4	-8.53×10^4	-2.26×10^5	2.83×10^5	-2.08×10^5	-1.08×10^5	-3.70×10^4
II	45	8.52×10^5	-4.26×10^4	**9.59×10^3**	**3.07×10^4**	**3.11×10^4**	-1.84×10^4	-8.32×10^4	$-1.10-\times10^5$	-2.91×10^5	-3.64×10^5	-2.67×10^5	-1.39×10^5	-4.75×10^4

1988	K (GPD/FT^2)	A (FT^2)	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT	OCT	NOV	DEC
HYDRAULIC GRADIENT			-1.27×10^{-3}	1.0×10^{-3}	7.1×10^{-4}	7.4×10^{-4}	-4.20×10^{-4}	-5.46×10^{-3}	-5.03×10^{-3}	-1.11×10^{-2}	-7.0×10^{-3}	-5.89×10^{-3}	-4.2×10^{-3}	NM
I	35	8.52×10^5	-3.79×10^4	**2.98×10^4**	**2.12×10^4**	**2.21×10^4**	-1.25×10^4	-1.63×10^5	-1.50×10^5	-3.31×10^5	-2.09×10^5	-1.76×10^5	-1.25×10^5	NM
II	45	8.52×10^5	-4.87×10^4	**3.83×10^4**	**2.72×10^4**	**2.84×10^4**	-1.61×10^4	-2.09×10^5	-1.93×10^5	-4.23×10^5	-2.68×10^5	-2.26×10^5	-1.61×10^5	NM

NOTES

All flux rate units provided in gallons.

I. Flux rates calculated using lower boundary hydraulic conductivity, K, (35 gpd/ft^2)

II. Flux rates calculated using upper boundary hydraulic conductivity, K, (45 gpd/ft^2)

Negative values indicate that ground-water flux is directed toward the center of the Alcoa Plant from the river.

Positive values are shown in bold pring and indicate that ground-water flux is directed toward the river from the Alcoa Plant.

28B/TBL-27.WP4

TABLE 28

ESTIMATED MAXIMUM GROUND-WATER FLUX TO THE MISSISSIPPI RIVER FROM THE BEDROCK AQUIFER, ALCOA-DAVENPORT PLANT

	LOW K FLUX VOLUME (GALLONS)	HIGH K FLUX VOLUME (GALLONS)	DURATION OF FLUX CONDITIONS (DAY)	AVERAGE DAILY FLUX		
				LOW K (gal/day)	HIGH K (gal/day)	MEDIAN (gal/day)
1987	1,700,000	2,280,000	93 days	18,280	24,515	21,398
1988	1,570,000	1,990,000	80 days	19,625	24,875	22,250

NOTES: Flux Rates Provided for only that Portion of the Bedrock Aquifer which may Contain Waste-Site VOCs (see Figure 50).

28B/TBL-28.WP4

TABLE 29

MEAN VOC CONCENTRATIONS AT THE ALCOA-DAVENPORT WASTE SITE+
(Concentrations in ppb)

	OCT. 1986	APRIL 1987	OCT. 1987	MAY 1988	OCT. 1988	APRIL 1989	COMBINED MEAN	HIGH MEAN
Vinyl Chloride	9.8 (12.2)	3.6 (6.0)	14.6 (17.0)	12.0 (14.4)	ND (4.0)	38.2 (15.35)	13.0 (15.4)	38.5
1,2-DCE	41.8 (42.6)	12.4 (14.8)	36.8 (37.6)	26.6 (28.2)	15.3 (16.7)	130.0 (130.2)	43.8 (45.0)	130.2
Other VOCs*	1.0 (4.2)	ND (4.0)	1.0 (4.2)	1.2 (4.4)	ND (4.0)	0.4 (0.8)	0.6 (3.6)	4.4
Toluene	2.4 (4.8)	ND (4.0)	1.4 (4.6)	ND (4.0)	3.3 (6.0)	1.0 (1.3)	1.4 (4.1)	6.0

NOTES: ND = Not Detected

* 1,1-DCE; 1,1-DCA; TCE; and chloroethane.

\+ For wells AS, GM-4, GM-6, GM-10, and GM-12

Mean Concentration Calculated Using Concentrations in Table 4.0.

Numbers in parentheses Represent the Mean Concentration Using the Concentrations in Table 4.0 Plus Adding Finite Concentrations for Nondetection (Equal to Approximately 1/2 Lab Detection Limit).

28B/TBL-29.WP4

TABLE 30

ESTIMATED VOC AND PCB LOADING RATES
TO THE MISSISSIPPI RIVER FROM THE
ALCOA-DAVENPORT WASTE SITE

COMPOUNDS	I CONCENTRATIONS (ug/l)		II CONCENTRATIONS (lbs/gal)		III LOADING RATE TO RIVER (lbs/day)		IV ANNUAL LOADING TO RIVER (lbs)	
	AVERAGE A	WORST CASE B	AVERAGE A	WORST CASE B	AVERAGE C	WORST CASE D	E	F
Vinyl Chloride	15.40	38.5	1.28×10^{-7}	3.22×10^{-7}	1.97×10^{-4}	9.97×10^{-4}	.072	0.36
1,2-DCE	45.0	130.2	3.76×10^{-7}	1.09×10^{-6}	5.79×10^{-4}	3.37×10^{-3}	0.211	1.23
Other VOCs+	3.6	4.4	3.01×10^{-8}	3.68×10^{-8}	4.64×10^{-5}	1.14×10^{-4}	0.017	0.04
Toluene	4.1	6.0	3.43×10^{-8}	5.02×10^{-8}	5.28×10^{-5}	1.55×10^{-4}	0.019	0.05
PCBs								
18.0+			1.50×10^{-7}	1.50×10^{-7}	2.31×10^{-4}	4.64×10^{-4}	0.084	0.16
54.0			4.51×10^{-7}	4.51×10^{-7}	6.95×10^{-4}	1.40×10^{-3}	0.254	0.51

NOTES: 1) Values in column II multiplied by flux rate discharging to river to obtain values in column II
2) Values provided in I and II determined using:
   A cumulative mean values (Table 29)
   B high mean values (Table 29)
3) Values provided in II determined using 1987 flux rates:
   average: 1540 gpd
   worst case: 3096 gpd
4) Annual loading values computed for 365 days
   E: average
   F: worst case

* Other VOCs: 1,1-DCE; 1,1-DCA; TCE; and, chloroethane
PCBs+ Represent solubility range of PCBs in water
18.0 ug/l
54.0 ug/l

28B\tbl-30.wp4

TABLE 31
MEAN VOC CONCENTRATIONS WITHIN THE
PORTION OF THE BEDROCK AQUIFER
DOWNGRADIENT FROM THE WASTE SITE+
(Concentrations in ppb)

	1985		1986	1987		1988		1989			
	March	December	October	April	October	May	October	April	October	MEAN	MAXIMUM CONCENTRATIONS
Vinyl Chloride	4.75 (7.75)	13.25 (16.25)	31.86 (33.57)	42.29 (43.43)	13.14 (16.0)	15.13 (19.50)	55.43 (57.14)	100.63 (102.63)		34.56 (37.03)	102.63
1,2-Dichloroethene	91.0 (92.0)	120.75 (122.75)	89.86 (91.0)	94.71 (95.85)	22.86 (27.43)	27.13 (28.13)	111.57 (112.14)	199.88 (201.38)		94.72 (96.34)	201.38
Other VOCs*	ND (4.0)	ND (4.0)	17.43 (20.29)	18.57 (20.28)	10.57 (13.43)	19.63 (25.13)	42.43 (48.15)	73.75 (78.75)		22.80 (26.75)	78.75
Toluene	ND (4.0)	10.25 (13.25)	ND (4.0)	ND (4.0)	ND (4.0)	ND (4.0)	ND (4.0)	ND (3.56)		1.28 (5.10)	13.25
Tetrachloroethane	ND (4.0)	ND (4.0)	ND (4.0)	ND (4.0)	ND (4.0)	0.88 (4.38)	61.43 (64.85)	67.50 (70.56)		16.23 (19.97)	70.56
1,1,1-Trichloroethane	ND (4.0)	ND (4.0)	ND (4.0)	ND (4.0)	ND (4.0)	ND (4.0)	ND (4.0)	0.75 (3.81)		0.09 (3.98)	3.98
Benzene	ND (4.0)	ND (4.0)	1.0 (4.43)	ND (4.0)	ND (4.0)	1.5 (5.00)	2.71 (5.88)	2.25 (5.25)		0.93 (4.57)	5.88

ND = Not Detected

+ For well clusters A, B, D, and FW-6

* 1,1-DCE; 1,1-DCA; TCE, and chloroethane
Compounds in Bold Print Represent Non Waste-Site VOCs
Mean Concentrations Calculated Using Concentrations in Table 6.0
Mean Concentrations in Parentheses Calculated Using Concentrations in Table 6.0 Plus Substitutions for Nondetection

tbl-mea.n2

TAI 2

ESTIMATED VOC LOADING TO THE MISSISSIPPI RIVER
FROM THE BEDROCK AQUIFER BENEATH THE
ALCOA-DAVENPORT PLANT

COMPOUNDS	I CONCENTRATIONS (ug/l) AVERAGE A	I WORST CASE B	II CONCENTRATIONS (lbs/gal) AVERAGE A	II WORST CASE B	III LOADING RATE TO RIVER (lbs/day) AVERAGE C	III WORST CASE D	IV ANNUAL LOADING TO RIVER (lbs) E	IV F
Vinyl Chloride	37.03	102.63	3.10×10^{-7}	8.58×10^{-7}	6.63×10^{-3}	2.10×10^{-2}	0.62	1.96
1,2-DCE	96.34	201.38	8.07×10^{-7}	1.68×10^{-6}	1.73×10^{-2}	4.12×10^{-2}	1.60	3.83
Other VOCs+	26.75	78.75	2.24×10^{-7}	6.58×10^{-7}	4.79×10^{-3}	1.61×10^{-2}	0.45	1.50
Toluene	5.10	13.25	4.26×10^{-8}	1.11×10^{-7}	9.12×10^{-4}	2.72×10^{-3}	0.08	0.25
PCE	19.97	70.56	1.67×10^{-7}	5.91×10^{-7}	3.57×10^{-3}	1.45×10^{-2}	0.33	1.34
1,1,1-TCA	3.98	3.98	3.33×10^{-8}	3.33×10^{-8}	7.13×10^{-4}	8.16×10^{-4}	0.07	0.08
Benzene	4.57	5.88	3.82×10^{-8}	4.92×10^{-8}	8.17×10^{-4}	1.21×10^{-3}	0.08	0.11

NOTE:
1) Values in column II multiplied by flux rate discharging to river to determine values in column III
2) Values provided in I and II determined using the following:
   A concentrations represent cumulative mean values (Table **)
   B concentrations represent high mean values (Table **)
3) Values provided in III determined using the ground-water flux volumes computed for 1987:
   min. 18,300 gpd, max. 24,500 gpd, median 21,400 gpd
   The loading rates provided under C were computed using median flux rate for 1987 and A concentrations
   The loading rates provided under D were computed using maximum flux rate for 1987 and B concentrations
4) Annual contaminant loading rates provided in IV were computed for the 93 days during 1987 when flux to the river occurred
   E values represent average estimated flux rates computed using A and C columns
   F values represent worst case estimated flux rates computed using B and D columns
   * VOCs in bold print represent non waste-site VOCs
   +Other VOCs: 1,1-DCE: 1,1-DCA; TCE; and Chloroethane

TBL-32.WP4

TABLE 33

SUMMARY OF VOLATILE ORGANIC COMPOUND CONCENTRATIONS IN MILL WATER SAMPLES COLLECTED AT ALCOA - DAVENPORT WORKS PLANT WATER RECLAMATION FACILITY AND COOLING TOWER APRIL AND AUGUST, 1989

VOCs	1		2		3	
	4/89	8/89	4/89	8/89	4/89	8/89
Vinyl chloride	16.0	2.0	13.0	-	-	-
1,1-Dichloroethane	2.0	-	2.0	-	-	-
1,2-Dichloroethylene (total)	12.0	9.0	8.0	7.0	-	-
Chloroform	33.0	24.0	32.0	19.0	17.0	4.0
Bromodichloromethane	1.0	3.0	1.0	2.0	-	-
Trichloroethene	16.0	11.0	14.0	10.0	-	-
Tetrachloroethene	28.0	500.0	26.0	540.0	2.0	21.0

All Concentrations Reported in ug/l.

--- Indicates that the Compound was not Present Above the Laboratory Detection Limit

1. Water Sample Collected from the Water Reclamation Facility where Mill Water is Initially Pumped into the Above Ground Tank.

2. Water Sample Collected from the Water Reclamation Facility where Mill Water is Discharged from the Above Ground Tank to the Cooling Tower.

3. Water Sample Collected after Mill Water has Passed through the Cooling Tower.

Note:
Complete 624 VOC Analysis Performed, Only those VOCs Present Above Laboratory Detection Limits are Provided here.

TABLE 34

Alcoa Davenport Works ISCLT Modeling - Mass Emission Rates and Ambient Air MEGs

Volatile Organic Compound*	"A"	"B"	Emission Rates Water Reclamation Tank	Emission Rates Water Reclamation Cooling Tower	MEG (1) (ug/M3)	TLV-TWA (2) (mg/M3)	TLV/420 (3) (ug/M3)
Vinyl Chloride*	3.0	13.0	0.002268	0.009828	1200.0	13.0	31.0
1,1-Dichloroethane*	0.0	2.0	0.000000	0.001512	----	810.0	1928.6
1,2-Dichloroethylene*	4.0	8.0	0.003024	0.006048	1880.0	793.0	1888.1
Chloroform	5.0	15.0	0.003780	0.011608	23.0	49.0	116.7
Bromodichloromethane	1.0	2.0	0.000756	0.001512	81.0	----	----
Trichloroethene*	2.0	14.0	0.001512	0.010584	1274.0	269.0	640.5
Tetrachloroethene	2.0	519.0	0.001512	0.392695	1595.0	339.0	807.1

"A" - Decrease in VOC concentration (ug/l) in Mill Water at the Alcoa Water Reclamation Facility between the Intake and Discharge Location in the Above Ground Tank.

"B" - Decrease in VOC concentration (ug/l) in Mill Water at the Alcoa Water Reclamation Facility After Flowing through the Cooling Tower.

(1) MEG - Toxicity based estimated permissible concentration, based upon health effects. Multimedia Environmental Goals for Environmental Assessment, Volume III

(2) TLV-TWA - The time weighted average concentration for a normal 8-hour workday and a 40-hour workweek, to which nearly all workers may be repeatedly exposed, day after day, without adverse healty effects. 1989-1990 ACGIH

(3) TLV/420 - Conversion of ACGIH TLV acceptable workplace exposure value to a conservative ambient air guideline.

* Represents VOCs detected at the waste site.

TABLE 35

ESTIMATED VOC CONTAMINATION OF THE MISSISSIPPI RIVER
FROM ALCOA-DAVENPORT (concentrations in ppb)

COMPOUND	SEEPAGE FROM WASTE SITE[A]		SEEPAGE FROM BEDROCK AQUIFER[B]		COMBINED SEEPAGE FROM WASTE SITE AND BEDROCK AQUIFER	
	WORST CASE	AVERAGE	WORST CASE	AVERAGE	WORST CASE	AVERAGE
Vinyl Chloride	6.65×10^{-3}	3.29×10^{-4}	4.34×10^{-3}	6.86×10^{-4}	1.10×10^{-2}	1.02×10^{-3}
1,2- Dichloroethene	2.24×10^{-2}	9.65×10^{-4}	8.52×10^{-3}	1.78×10^{-3}	3.09×10^{-2}	2.75×10^{-3}
Other VOCs*	7.60×10^{-4}	7.73×10^{-5}	3.33×10^{-3}	4.96×10^{-4}	4.09×10^{-3}	5.73×10^{-4}
Toluene	1.03×10^{-3}	8.80×10^{-5}	5.63×10^{-4}	9.43×10^{-5}	1.59×10^{-3}	1.82×10^{-4}
Tetrachloroethene	NA	NA	3.00×10^{-3}	3.69×10^{-4}	3.00×10^{-3}	3.69×10^{-4}
1,1,1-TCA	NA	NA	1.69×10^{-4}	7.38×10^{-5}	1.69×10^{-4}	7.38×10^{-5}
Benzene	NA	NA	2.23×10^{-4}	8.45×10^{-5}	2.23×10^{-4}	8.45×10^{-5}

28B/tbl-35.wp4

TABLE 3

ESTIMATED VOC CONTAMINANTION OF THE MISSISSIPPI RIVER
FROM ALCOA-DAVENPORT (concentrations in ppb)
(Continued)

NOTES:

[A] 250 foot discharge zone

[B] 750 foot discharge zone

NA = Not Applicable

Assumptions for Worst Case Scenario:
1) Minimal flow in the Mississippi River (0.027 ft/sec near shore and .136 ft/sec offshore)
2) Maximum mean contaminant loading concentrations and flux rates

Assumptions for Average Conditions Scenarios:
1) Low flow rate for the Mississippi River (0.069 ft/sec near-shore and 0.272 ft/sec off-shore in bedrock aquifer discharge zone);
2) Steady state conditions;
3) Average contaminant loading concentrations; flux rates; and,
4) No reduction in contamination due to chemical and physical processes.

* 1,1-DCE; 1,1-DCA; TCE; Chloroethane

Compounds in bold print represent non waste-site VOCs

28B/tbl-35.wp4

TABLE 36

ESTIMATED CONTAMINATION
OF THE MISSISSIPPI RIVER WITH PCB AROCLOR 1248
(All Concentrations Reported in ppb)

SCENARIO	PCB LOADING FROM WASTE SITE		PCB LOADING FROM BEDROCK AQUIFER	PCB LOADING FROM* RIVER SEDIMENTS	CUMULATIVE ESTIMATED PCB CONCENTRATIONS IN RIVER	
	18.0+	54.0+			18.0+	54.0+
[1]WORST CASE	3.10×10^{-3}	9.30×10^{-3}	NA	6.2×10^{-2}	6.51×10^{-2}	7.13×10^{-2}
[2]AVERAGE CONDITIONS	3.9×10^{-4}	1.16×10^{-3}	NA	5.6×10^{-3}	5.99×10^{-3}	6.76×10^{-3}

NOTES:

NA = Not Applicable

[1]Assumptions for Worst Case Scenario:
1) Minimal Flow in Mississippi River is 0.027 ft/sec (1 ft/37 sec)
2) Maximum Seepage Rate to River (3096 gpd)

[2]Assumptions for Average Conditions Scenario:
1) Conservatively Low Flow in Mississippi River is 0.069 ft/sec (1 ft/14.5 sec)
2) Average Seepage Rate to River (1540 gpd)

18.0+ PCB Aroclor 1248 Solubility Limit in Water Most Representative of Site Conditions
54.0+ PCB Aroclor 1248 Solubility Limit in Water Based on EPA Literature Value
* PCB Loading Rate to River from Sediments Obtained from YMA FGETS Report (YMA, 1990)

TABLE 37

Annual average ground level concentraton results for specific point of interest
Values presented are in units of micrograms per cubic meter (ug/M3)

Volatile Organic Com	School	Fence 1	Fence 2	Fence 3	Fence 4	Fence 5	Fence 6	Fence 7	Fence 8	Fence 9	Fence 10
Vinyl Chloride	0.002151	0.002361	0.007912	0.006271	0.003940	0.003843	0.004828	0.005045	0.004418	0.006941	0.005927
1,1-Dichloroethane	0.000123	0.000201	0.000686	0.000524	0.000236	0.000241	0.000426	0.000496	0.000432	0.000580	0.000148
1,2-Dichloroethylene	0.002292	0.002208	0.007349	0.005918	0.004151	0.003998	0.004449	0.004411	0.003874	0.006547	0.007214
Chloroform	0.003195	0.003299	0.011023	0.008799	0.005821	0.005643	0.006702	0.006842	0.005999	0.009737	0.009412
Bromodichloromethane	0.000573	0.000552	0.001837	0.001479	0.001038	0.000999	0.001112	0.001103	0.000969	0.001637	0.001803
Trichloroethene	0.001762	0.002111	0.007103	0.005577	0.003257	0.003205	0.004355	0.004686	0.004097	0.006175	0.004345
Tetrachloroethene	0.032901	0.053020	0.180397	0.137912	0.062977	0.064161	0.112049	0.130077	0.113293	0.152792	0.041631

* Figure 3-1 illustrates the orientation of the ten fence line receptors and the school receptor.

TABLE 38

Magnitude of Exposure Resulting from Contact with Contaminants in the Mississippi River as a Result Discharge from Alcoa Waste Site, Riverdale, Iowa.

Contaminant	Short-Term "Worst"	Conservative "Long-Term Conditions"	Short-Term "Worst"	Conservative "Long-Term Conditions"
Vinyl chloride	1.10E-05	1.02E-06	1.17E-09	1.08E-10
1,2-Dichloroethene	3.09E-05	2.75E-06	3.28E-09	2.92E-10
Other Chlorinated VOCs*	4.09E-06	5.73E-07	4.34E-10	6.08E-11
Toluene	1.59E-06	1.82E-07	1.69E-10	1.93E-11
Tetrachloroethene	3.00E-06	3.69E-07	3.18E-10	3.92E-11
1,1,1-Trichloroehtane	1.69E-07	7.38E-08	1.79E-11	7.83E-12
Benzene	2.23E-07	8.45E-08	2.37E-11	8.97E-12
PCBs (54 ppb sol.)	7.13E-05	6.32E-05	7.57E-09	6.71E-09

$$CDI = A+B$$

$$A = \frac{(SWC)\ (SA)\ (WFR)\ (EVD)\ (EF)\ (EXD)\ (UC[1])}{(BW)\ (UC[2])}$$

$$B = \frac{(SWC)\ (SA)\ (WIR)\ (EF)\ (EVD)\ (EXD)}{(BW)\ (UC[2])\ (UC[3])}$$

BW	[c]	Adult body weight (kg).
CDI	[b]	Chronic daily intake (mg/kg bw/day).
EF	[d]	Event frequency (days/year).
EVD	[e]	Event duration (hrs/event).
EXD	[f]	Exposure duration (years/lifetime).
SA	[g]	Surface area available for contact (cm2).
SWC	[a]	Surface water concentration (mg/l).
UC	[1]	Unit conversion (1E-6 l/mg).
UC	[2]	Unit conversion (27,375 d/lifetime).
UC	[3]	Unit conversion (1000 ml/l).
WFR	[h]	Water flux rate (mg/cm2.hr).
WIR	[i]	Water ingestion rate (ml/hr).

TABLE 38

Magnitude of Exposure Resulting from Contact with Contaminants in the Mississippi River as a Result Discharge from Alcoa Waste Site, Riverdale, Iowa.
(Continued)

c Assumes an adult weighs 70 kg.
d An adult waterskis in this water 51 days/year.
e Assumes adult waterskis for 3 hr during which times he/she falls in water 6 times and spends 10 min. in water (1 hr/event)
f An adult waterskis in this water during ages 15-40 (for 25 yrs/lifetime).
g For exposure to water, available surface area is the whole body or 19,000 cm2. (USEPA, 1988a).
h Water flux rate is assumed to be 0.5 mg/cm2hr.
i Gulping map result in an intake of 150 ml/hr (3 times the normal assumed gulping intake of 50 ml/hr [USEPA, 1989a]).

* Includes 1,1-dichloroethene, 1,1-dichloroethane, trichloroethene and chloroethane.

TABLE 39

INHALATION EXPOSURE DOSES FOR AIR AFFECTED BY THE SITE, RIVERDALE, IOWA

Contaminant	Concentration in Air [a] (ug/m3)	Exposure Dose (mg/kg bw/d)
Bromodichloromethane	0.001837	1.5E-07
Chloroform	0.011023	9.1E-07
1,1-Dichloroethane	0.000686	5.6E-08
1,2-Dichloroethene	0.007349	6.0E-07
Tetrachloroethene	0.180397	1.5E-05
Trichloroethene	0.007103	5.8E-07
Vinyl chloride	0.007912	6.5E-07

[a] Concentrations in air are for the position designated "Fence 2", Table 2-1, Appendix __.

$$\text{Exposure Dose} = \frac{(IR)(CONA)(RLIF)(EXD)(UC)}{(LIF)(BW)}$$

BW	Body weight (70 kg) (USEPA, 1988a).
IR	Inhalation rate (0.6 m3/hr). Assumes light activity (USEPA, 1989a).
CONA	Concentration in air (ug/m3).
EXD	Exposure duration (24 hours/day).
LIF	Lifetime (27,375 days) (USEPA, 1989a).
RLIF	Lifetime in residence (30 years or 10,950 days) (USEPA, 1989a).
UC	Unit conversion (0.001 mg/ug).

TABLE 40

ACCEPTABLE DOSES, CANCER POTENCY FACTORS, AND
U.S. ENVIRONMENTAL PROTECTION AGENCY CANCER CLASSIFICATION OF
CONTAMINANTS DETECTED AT THE ALCOA WASTE SITE, RIVERDALE, IOWA

	AD[a] (mg/kg/day)		q*[a]		Cancer
Contaminant	Oral	Inhalation	Oral	Inhalation	Classification
Aroclor 1248	0.0001[b]	(0.0001)	7.7[b]	(7.7)	B2
Benzene	0.0007[c]	0.0007[c]	0.029	0.029	A
Chloroform	0.01	(0.01)	0.0061	0.081	B2
1,1-Dichloroethane**	0.1[d]	0.1[d]	0.091[d]	(0.091)	B2
1,1-Dichloroethene	0.009	(0.009)	0.6	1.2	C
c-1,2-Dichloroethene	0.01[e]	(0.01)	-	-	D
t-1,2-Dichloroethene	0.02	(0.02)	-	-	D
Toluene	0.3	1.0[d]	-	-	D
Tetrachloroethene	0.01	(0.01)	0.051[d]	0.0033[d]	B2
1,1,1-Trichloroethane	0.09	0.3[d]	-	-	D
Trichloroethene	0.0074[f]	(0.0074)	0.011	0.013	B2
Vinyl Chloride	0.0013[g]	(0.0013)	2.3[d]	0.295[d]	A

a Source of ADs and q*s was IRIS unless otherwise noted. If data for the inhalation route were not available, the oral data were used (number in parenthesis).

b USEPA, 1988b.

c USEPA, 1986b.

d USEPA, 1989c.

e Based on the proposed MCLG.

f USEPA, 1987.

g Dow Chemical Co., 1984.

** Although the USEPA (1989c) lists 1,1 DCA as a B_2 carcinogen based on its structural similarity to 1,2 DCA, it should be noted that this designation has not been verified.

TABLE 41

TOXICITY SUMMARIES FOR CONTAMINANTS DETECTED AT
THE ALCOA WASTE SITE, RIVERDALE, IOWA

Contaminant	Acute Toxicity Summary	Chronic Toxicity Summary	Carcinogenic Potential	Other Effects
Aroclor 1248	Liver enzyme changes, liver and kidney damage, weight loss, hemorrhaging, and skin effects at high doses.	Chloracne, burning eyes and skin, immunosuppression, induction of cytochrome P-450, hepatomegally.	Hepatocellular carcinomas produced in rats. Evidence indicates that PCBs probably act as promoters. Insufficient evidence to classify as a human carcinogen.	Fetotoxic but not likely teratogenic. Most mutagenic studies have been negative.
Benzene	Primarily central nervous system (CNS) effects such as dizziness, exhiliration, nausea, vomiting, headache, staggering, loss of balance, narcosis, coma, and death. Effects are rapidly reversible and concentration-dependent.	Hematological poison causing aplastic anemia, immune system depression, and susceptibility to tuberculosis and pneumonia. Terminal event in severe benzene toxicity is often acute overwhelming infection.	Benzene has produced both solid tumors and leukemia in rats orally dosed. Epidemiologic evidence of increased cancer incidence following inhalation exposure. EPA group A: Human Carcinogen.	Low levels of benzene do not elicit CNS effects no matter how long the exposure.
Chloroethane	CNS and cardiac depression, and nausea at high inhalation doses (>20,000 ppm). Has caused death in humans when used as an anesthetic. Also may irritate eyes and skin. Kidney and liver effects reported in animals.	No non-cancer effects reported in 2-year study of rats exposed to 15,000 ppm. Mild kidney effects and hyperactivity reported in mice exposed to 15,000 ppm for two years. One report of narcotic use in humans indicated cerebellar dysfunction which was reversible.	Recently completed study from inhalation exposure reported significant increase in uterine carcinomas and hepatocellular carcinomas in female mice. Equivocal evidence in rats for carcinogenicity.	Equivocal evidence for genotoxic effects. No evidence for reproductive or developmental effects.
Chloroform	Chloroform was previously widely used as an anesthetic because of its narcotic effect. Prenarcosis central nervous system effects include dizziness, giddiness, and exhilaration. Post-narcotic effects include mental dullness, fatigue, headaches and nausea.	Chronic administration of chloroform has resulted in kidney and liver disorders.	Epidemiologic studies suggest that chloroform and other trihalomethanes in the drinking-water supply may be associated with increased bladder cancer in humans. These reports do not establish causality. A dose-related increase in kidney epithelial tumors in rats and hepatocellular carcinomas in mice has been observed.	Chloroform is not mutagenic in bacterial assays. Oral doses which result in maternal toxicity result in mild fetal toxicity, in the form of reduced birth weight.

TABLE 41
TOXICITY SUMMARIES FOR CONTAMINANTS DETECTED AT
THE ALCOA WASTE SITE, RIVERDALE, IOWA
(Continued)

Contaminant	Acute Toxicity Summary	Chronic Toxicity Summary	Carcinogenic Potential	Other Effects
1,1-Dichloroethane	Inhalation exposure results in CNS depression and skin irritation, drowsiness, un-	Kidney and liver damage observed in animals exposed to high concentrations. Some consciousness. Inhalation of high doses (>16,000 mg/m^3) caused retarded fetal development in rats.	NCI bioassay inconclusive for laboratory animals. No epidemiological evidence in humans. evidence of hepatotoxicity in animals.	Not mutagenic in Ames assay.
1,1-Dichloroethene	Acute exposure to high doses causes CNS depression.	Neurotoxicity has not been associated with low-level chronic exposure. Chronic exposure to oral doses as low as 5 mg/kg/day caused liver changes in rats.	Causes kidney tumors (in males only) and leukemia in one study of mice exposed by inhalation, but the results of other studies were equivocal or negative.	Mutagenic in several bacterial assays. Did not appear to be teratogenic but did cause embryotoxicity and fetotoxicity when administered to rats and rabbits by inhalation.
c-1,2-Dichloroethene	CNS depression, nausea, fatty liver, and transient renal	No data available for chronic exposures. Liver and kidney toxicity. Also irritates skin and mucous membranes.	Has not yet been studied for carcinogenicity. effects likely.	Mutagenic and genotoxic effects reported in mice.
t-1,2-Dichloroethene	High concentrations have anesthetic properties as a result of CNS depression. Irritation of eyes and respiratory system.	Repeated exposure via inhalation of 800 mg/m^3 reportedly produced fatty degenration of the liver in rats. Possible interaction with hepatic drug-metabolizing	No data available. using E. coli, Salmonella, or mouse bonemarro cells.	Not mutagenic in assays monooxygenase.
Tetrachloroethane	Short-term inhalation exposure in humans can result in depression of the CNS characterized by dizziness, impaired memory, confusion, irritability "inebriation-like" symptoms, tremors, and numbness. Impairment, hepatitis, and enlargement of the spleen and liver have been reported.	Very little data are available concerning long-term exposure. Hepatotoxic effects have been documented for long-term inhalation exposures to workers as have hepatitis, cirrhosis, liver-cell necrosis, enlarged liver, and kidney disease. Oral exposures in experimental animals resulted in minor liver impact in rats.	Found to produce liver cancer in mice. Inhalation studies with rats have yielded evidence of carcinogenicity (leukemia). No epidemiological studies conclusively linking human exposure to carcinogenicity.	Animal studies suggest potential teratogenic and embryotoxic effects.

TABLE 41

TOXICITY SUMMARIES FOR CONTAMINANTS DETECTED AT
THE ALCOA WASTE SITE, RIVERDALE, IOWA
(Continued)

Contaminant	Acute Toxicity Summary	Chronic Toxicity Summary	Carcinogenic Potential	Other Effects
1,1,1-Trichloroethane	Depression of the CNS is the primary toxic effect in humans from short-term, high-level inhalation exposures. Some have been fatal. Acute, high-level exposures can also adversely affect the cardiovascular system. Accidental ingestion resulted in CNS depression and gastrointestinal upset. It is irritating to skin; liquid can be absorbed through the skin. Acute exposures indicate that this compound is relatively non-toxic, aside from CNS effects. The oral LD_{50}s (rats) is about 11,000 mg/kg.	Long-term inhalation studies in animals resulted in liver changes. Occupational studies did not indicate any statistically significant effects after prolonged inhalation exposures. It appears to be no more toxic upon long-term exposure than acute exposure. Long oral doses given test animals over a 78-week period indicated little apparent histopathological change in any organ.	Recent NTP study inconclusive. No evidence of carcinogenicity.	Equivocal evidence of mutagenicity from bacterial assays.
Toluene	CNS effects such as: fatigue, weakness, confusion, euphoria, dizziness, headache, insomnia, muscular weakness, and incoordination.	Chronic exposure to vapors at 200 to 800 ppm associated with disturbances in memory, thinking, psychomotor skill, visual accuracy, and sensorimotor skills. Cerebral and cerebellar dysfunction reported in chronic abusers of toluene, as well as hepatic and renal function changes. Oral administration to mice at doses of 260 mg/kg has increased embryonic lethality, 434 mg/kg has decreased fetal weight and 867 mg/kg has increased the incidence of cleft palate.	No evidence of carcinogenicity.	Not genotoxic in various assays by many investigators. No reports of teratogenic effects to humans.

TABLE 41

TOXICITY SUMMARIES FOR CONTAMINANTS DETECTED AT
THE ALCOA WASTE SITE, RIVERDALE, IOWA
(Continued)

Contaminant	Acute Toxicity Summary	Chronic Toxicity Summary	Carcinogenic Potential	Other Effects
Trichloroethene	Manifestation of TCE exposure in CNS depression is demonstrated by dizziness, headache, visual disturbances, incoordination similar to that induced by alcohol, tremors, sleepiness, nausea, and vomiting. Cardiac arrhythmias and death due to ventricular fibrillation and cardiac arrest from acute exposure above 15,000 ppm. Accidental ingestion of about 150 ml resulted in acute kidney failure, and liver and cardiovascular damage. Local exposure to TCE vapors may cause irritation to eyes, nose, throat.	Prolonged occupational exposure to vapors (200 to 400 ppm) resulted in CNS symptoms including headache,. dizziness, tremors, sleepiness, fatigue, and vomiting. These symptoms were reversible. Lower exposures (100 to 200 ppm) to humans resulted in biochemical changes in liver function. In test animals, chronic exposure induces low to moderate liver and kidney toxicity. Prolonged exposures to test animals at levels greater than 2,000 mg/m^3 resulted in renal toxicity, hepatotoxicity, and neurotoxicity.	Has produced increase in heptacellular carcinomas in mice after oral administration. Other tests with mice and rats haveproduced negative results. Human epidemiological data are inconclusive.	Mutagenic in some bacterial test systems.
Vinyl chloride	At high levels, CNS effects occur, including dizziness, headaches, euphoria, narcosis death. Lower doses have resulted in ataxia, congestion, and edema in lungs, and hyperemia in liver.	Reported chronic toxicity symptoms of workers include hepatotoxicity, acro-osteolysis, CNS disturbances, pulmonary insufficiency, cardiovascular toxicity, and gastrointestinal toxicity.	Liver angiosarcomas as well as tumors of the brain, lung, hematopoietic tissues, and lymphopoietic tissues have been associated with occupational exposure. Vinyl chloride is reported to be carcinogenic in rats, mice and hamsters.	Mutagenic in bacterial and mammalian cell test systems. Equivocal evidence of possible teratogenic or reproductive effects.

TABLE 42

Excess Lifetime Cancer Risk and Hazard Indices Associated with Water Skiing in Affected Water, Alcoa Waste Site, Riverdale, Iowa.

Contaminant	SWED [a] (mg/kg/day)	Cancer Potency Factor (mg/kg/day)	Acceptable Daily Dose (mg/kg/day)	Excess Lifetime Cancer Risk [b]	Hazard Index [c]
Vinyl chloride	1.2E-09	2.3E+00	1.3E-03	2.7E-09	9.0E-07
1,2-Dichloroethene	3.3E-09	-	1.0E-02	-	3.3E-07
Other chlorinated VOCs [d]	4.3E-10	1.1E-02	7.4E-03	4.8E-12	5.9E-08
Toluene	1.7E-10	-	3.0E-01	-	5.6E-10
Tetrachloroethene	3.2E-10	5.1E-02	1.0E-02	1.6E-11	3.2E-08
1,1,1-Trichloroethane	1.8E-11	-	9.0E-02	-	2.0E-10
Benzene	2.4E-11	7.0E-04	2.9E-02	1.7E-14	8.2E-10
PCBs	7.6E-09	7.7E+00	1.0E-04	5.8E-08	7.6E-05
			Total	6.1E-08	7.7E-05

[a] SWED is short-term worst case surface water exposure dose (From Table XI.A).
[b] Excess lifetime cancer risk = SWED x cancer potency factor.
[c] Hazard index = SWED/acceptable daily dose.
[d] Toxicity values for trichloroethene are used for other chlorinated VOCs.
mg/kg/day Milligrams per kilogram per day.

TABLE 43

Excess Lifetime Cancer Risk and Hazard Indices Associated with Affected Air, Alcoa Waste Site, Riverdale, Iowa

Contaminant	Exposure Dose [a] (mg/kg bw/day)	Cancer Potency Factor (mg/kg bw/day)[-1]	Acceptable Dose (mg/kg bw/day)	Excess Lifetime Cancer Risk [b]	Hazard Index [c]
Vinyl chloride	6.5E-07	3.0E-01	1.3E-03	1.9E-07	5.0E-04
1,1-Dichloroethane	5.6e-08	9.1E-02	1.0E-01	5.1E-09	5.6E-07
1,2-Dichloroethene	6.0E-07	-	1.0E-02	-	6.0E-05
Chloroform	9.1E-07	8.1E-02	1.0E-02	7.3E-08	9.1E-05
Bromodichloromethane[d]	1.5E-07	8.1E-02	1.0E-02	1.2E-08	1.5E-05
Trichloroethene	5.8E-07	1.3E-02	7.4E-03	7.6E-09	7.9E-05
Tetrachloroethene	1.5E-05	3.3E-03	1.0E-02	4.9E-08	1.5E-05
			Total	3.4E-07	2.2E-03

[a] Exposure dose from Table X1.B.
[b] Excess lifetime cancer risk = Exposure dose x cancer potency factor.
[c] Hazard index = Exposure dose/acceptable dose.
[d] Chloroform values (cancer potency factor and acceptable dose) were used for bromodichloromethane.

TABLE 44

TOXICITY OF SELECTED PCBS TO AQUATIC ORGANISMS.

Acute Toxicity Species	Aroclor	Bioassay Test Length	LC (ug/l)	Reference
Channel catfish	1248	4 days	6,000	Stalling & Mayer, 1972
Channel catfish	1254	4 days	12,000	Stalling & Mayer, 1972
Bluegill sunfish	1248	4 days	278	Stalling & Mayer, 1972
Bluegill sunfish	1254	4 days	2,740	Stalling & Mayer, 1972
Channel catfish (egg to larvae)	1242	4 days	4.2	Birge et al., 1978
Channel catfish (egg to larvae)	1254	4 days	1.8	Birge et al., 1978
Redear sunfish (egg to larvae)	1242	4 days	3.6	Birge et al., 1978
Redear sunfish (egg to larvae)	1254	4 days	0.5	Birge et al., 1978
Fathead minnow (egg to larvae)	1254	4 days	7.7	Nebeker et al., 1974
Amphipod	1248	4 days	29 - 52	Mayer et al.,1977 Nebeker & Puglisi, 1974
Damselfly	1242	4 days	400	Mayer et al., 1977
Damselfly	1254	4 days	200	Mayer et al., 1977
Leopard Frog (egg to larvae)	1242	4 days	2.1	Birge et al., 1978
Leopard Frog (egg to larvae)	1254	4 days	1.0	Birge et al., 1978

TABLE 44

TOXICITY OF SELECTED PCBS TO AQUATIC ORGANISMS.
(Continued)

Sub-Chronic Toxicity				
Channel catfish	1242	15 days	107	Stalling & Mayer, 1972
Channel catfish	1248	15 days	127	Stalling & Mayer, 1972
Channel catfish	1254	15 days	741	Stalling & Mayer, 1972
Channel catfish	1248	30 days	75	Mayer et al., 1977
Bluegill sunfish	1242	15 days	54	Stalling & Mayer, 1972
Bluegill sunfish	1248	30 days	78	Mayer et al., 1977
Bluegill sunfish	1254	15 days	204	Mayer et al., 1977
Fathead minnow (egg to larvae)	1248	30 days	4.7	DeFoe et al., 1978
Cladoceran	1248	14 days	2.6	Nebeker & Puglisi, 1974
Cladoceran	1254	14 days	1.8	Nebeker & Puglisi, 1974
Chronic Toxicity				
Fathead minnow	1248	Life-cycle	0.2[a]	DeFoe et al., 1978
Amphipod	1248	Life-cycle	3.3[a]	Nebeker et al., 1974
Cladoceran	1254	Life-cycle	2.1[a]	Nebeker & Puglisi, 1974
Cladoceran	1248	Life-cycle	4.3[a]	Nebeker & Puglisi, 1974
Midge	1254	Life-cycle	0.8[a]	Nebeker & Puglisi, 1974

[a] Chronic values as cited in USEPA, 1980.
ug/l Micrograms per liter.

APPENDIX A

Appendix A

Soil Boring Lithology Logs

A-I	Waste Site Borings
A-II	Bedrock Borings
A-III	Building Expansion Borings
A-IV	Production Well Logs

LOG OF BORING NO. GMB-1

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	PA										
1	SS	18	8	50							FILL - SAND, GRAVEL, CONCRETE RUBBLE AND CINDERS, Gray and Dark Gray
2	SS	18	10	22							
3	SS	18	5	26					5		
4	SS	18	4	8							(7.5)
5	SS	18	16	35							(8.2) SEE NOTE #1
	PA										(9.0) SEE NOTE #2
									10		Bottom of Boring @ 9.0'
											Auger Refusal @ 9.0'
									15		
									20		
									25		
									30		

NOTE #1:
CLAYEY SILT, TRACE SAND, Brown

NOTE #2:
WEATHERED LIMESTONE, Gray

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				
W.L.	None	W.S. OR W.D.	None	A.B.
W.L.		B.C.R.		A.C.R.
W.L.				

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED	2/6/81
BORING COMPLETED	2/6/81
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GMB-2

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description
	HS										
1	SS	18									
2	SS	18									CLAYEY SILT, TRACE GRAVEL, SILT, TRACE CLAY, FINE TO MEDIUM SAND, Dark Gray and Black
3	SS	18							5		
4	SS	18									
5	SS	18									
6	SS	15		30/2''							(9.5)
	HS								10		(10.5) WEATHERED LIMESTONE, Gray
											Bottom of Boring @ 10.5'
											Auger Refusal @ 10.5'
									15		12.7' PVC and Screen set 2/14/81.
											Hole redrilled 2/14/81.
									20		
									25		
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	None W.S. OR W.D.	None A.B.	
W.L.	B.C.R.	A.C.R.	
W.L.	Wet Cave In @ 9.1'		

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED	2/9/81
BORING COMPLETED	2/9/81
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GMB-3

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS										
1	SS	18	15	7							CLAYEY SILT, TRACE SAND, Dark Gray
2	SS	18	15	12							
3	SS	18	18	12					5		(5.5) LIMESTONE @ 5.4'
											Bottom of Boring @ 5.5'
											Auger Refusal @ 5.5'
									10		
											8' PVC and Screen Set 2/14/81.
									15		
									20		
									25		
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES. IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	5.4 W.S. OR W.D.	5.4 A.B.	
W.L.	B.C.R.	A.C.R.	
W.L.			

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 2/9/81	
BORING COMPLETED 2/9/81	
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GMB-4

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS										CLAYEY SILT, TRACE SAND AND ORGANICS,
1	SS	18	8	11							Dark Gray
2	SS	15	5	40/5"							(3.7) LIMESTONE @ 3.6'
									5		Bottom of Boring @ 3.7'
											Auger Refusal @ 3.7'
									10		6.5' PVC and Screen Set 2/14/81.
									15		
									20		
									25		
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS					
W.L.	None	W.S. OR W.D.	None	A.B.	
W.L.		B.C.R.		A.C.R.	
W.L.					

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED	2/9/81
BORING COMPLETED	2/9/81
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-1

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	PROJECT NAME
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
1	SS	18	5	50/5'							
2	SS	18	12	34							FILL - SAND, GRAVEL, SILT, CONCRETE RUBBLE, Gray and Dark Gray
3	SS	18	16	22							
4	SS	18	10	15					5		
5	SS	18	3	12							
6	SS	18	16	22							(8.5)
7	SS	18	14	13					10		(10.1) CLAYEY SILT, TRACE SAND, Dark Gray
8	SS	18	2	70/2"							(11.5) WEATHERED LIMESTONE, Gray
									15		Bottom of Boring @ 11.5' Auger Refusal @ 11.5' 14' PVC and Screen Set 2/14/81. Hole redrilled 2/14/81.
									20		
									25		
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS					Terracon Consultants, Inc.	BORING STARTED	2/6/81
W.L.	None	W.S. OR W.D.	10.6	A.B.	Cedar Rapids Davenport Des Moines, IA	BORING COMPLETED	2/6/81
W.L.		B.C.R.		A.C.R.	Kansas City Wichita, KS	RIG Mobile B53	FOREMAN JAF
W.L.						APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-2

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	PA										
1	SS	18	18	26							FILL - SILT, TRACE CLAY AND SAND, CINDERS, RUBBLE, CONCRETE AND LIMESTONE, Brown
2	SS	18	18	14							
3	SS	18	6	63					5		
4	SS	18	18	22							(6.8)
5	SS	18	18	12							SILTY FINE SAND WITH OCCASIONAL LIMESTONE CHUNKS, Dark Gray
6	SS	18	18	3					10		
7	SS	18	18	11							
8	SS	18	6	12							(13.0)
	PA										(14.0) WEATHERED LIMESTONE, Gray
									15		Bottom of Boring @ 14.0'
											Auger Refusal @ 14.0'
									20		13.9' PVC and Screen Set 2/14/81. Hole redrilled 2/14/81.
									25		
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS					BORING STARTED	2/6/81
W.L.	9.0	W.S. OR W.D.	11.0	A.B.	BORING COMPLETED	2/6/81
W.L.		B.C.R.		A.C.R.	RIG Mobile B53	FOREMAN JAF
W.L.					APPROVED TAS	JOB # 780607

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

LOG OF BORING NO. GM-3

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	PROJECT NAME
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	PA										
1	SS	18	18	27							FILL - SAND, GRAVEL, SILT, TRACE CLAY, DRY SLUDGE, PROCESSING WASTE, Gray, Dark Gray and Pink
2	SS	18	18	33							
3	SS	18	18	5					5		
4	SS	18	10	27							(6.7)
5	SS	18	3	33							WEATHERED LIMESTONE, Gray
6	SS	18	3	5							
7	SS	2	2	28/2"					10		(10.4)
	PA										Bottom of Boring @ 10.5'
											Auger Refusal @ 10.5'
									15		
											13.9' PVC and Screen Set 2/14/81.
											Hole redrilled 2/14/81.
									20		
									25		
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				Terracon Consultants, Inc.	BORING STARTED	2/6/81
W.L.	8.5	W.S. OR W.D.	A.B.	Cedar Rapids Davenport Des Moines, IA	BORING COMPLETED	2/6/81
W.L.		B.C.R.	A.C.R.	Kansas City Wichita, KS	RIG Mobile B53	FOREMAN JAF
W.L.					APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM -4

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol
	HS							
1	SS	18	12	19				
2	SS	18	16	19				
3	SS	18	18	11				
4	SS	18	6	32/3"				
5	SS	18	16	15				
6	SS	18	14	8				
7	SS	18	15	8				
8	SS	18	12	9				
9	SS	18	12	5				
10	SS	18	6	3				
11	SS	1	1	8/1'				

Depth: 5, 10, 15, 20, 25, 30

Elevation

Description

4" Crushed Limestone

CLAYEY SILT, TRACE SAND AND LIMESTONE CHUNKS, Brown

(10.3)

(11.1) FINE SAND, TRACE GRAVEL, Brown

SILT, TRACE CLAY AND SAND, Gray Brown

(16.5) LIMESTONE @ 16.1'

Bottom of Boring @ 16.5'

Auger Refusal @ 16.5'

19.5' PVC and Screen Set 2/14/81.

Hole redrilled 2/14/81.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS		
W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.	Well Set 2/14/81	

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED	2/9/81
BORING COMPLETED	2/9/81
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-5

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS										
1	SS	18	16								
2	SS	18	10								FILL - SILT, LITTLE CLAY, TRACE SAND AND LIMESTONE PIECES, Brown and Dark Brown
3	SS	18	18						5		
4	SS	18	11	46/5"							
5	SS	18	2								
6	SS	18	6						10		
7	SS	18	6								(12.0)
8	SS	18	12								SILT, TRACE CLAY AND SAND, Gray
9	SS	13	7								(13.5)
	RB								15		
RUN 1	DB	120	120	100 % Recovery					20		WEATHERED LIMESTONE, Gray
RUN 2	DB	120	120	100 % Recovery					25		(30.0)
									30		Continued On Sheet #2

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			Terracon Consultants, Inc.		
W.L.	None W.S. OR W.D.	A.B.	Cedar Rapids Davenport Des Moines, IA	BORING STARTED	2/9/81
W.L.	B.C.R.	A.C.R.	Kansas City Wichita, KS	BORING COMPLETED	2/16/81
W.L.	Water Loss @ 38.0'			RIG Mobile B53	FOREMAN JAF
				APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-5 (Continued)

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	PROJECT NAME
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											(30.0) Continued From Sheet #1
RUN 2	DB	120	120	100	% Recovery				30		WEATHERED LIMESTONE, Gray
RUN 3	DB	108	108	100	% Recovery				35, 40		(43.1)
									45, 50, 55, 60		Bottom of Boring 22' PVC and Screen Set 2/16/81. Hole redrilled 2/16/81. 10' Screen Used

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS					
W.L.	None W.S. OR W.D.	A.B.	Terracon Consultants, Inc.	BORING STARTED 2/9/81	
W.L.	B.C.R.	A.C.R.	Cedar Rapids Davenport Des Moines, IA	BORING COMPLETED 2/16/81	
W.L.	Water Loss @ 38.0'		Kansas City Wichita, KS	RIG Mobile B53	FOREMAN JAF
				APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM- 6

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation
	HS									
1	SS	18	7	50						
2	SS	18	12	41						
3	SS	18	10	51					5	
4	SS	18	2	17						
5	SS	18	10	9						
6	SS	18	10	12						
7	SS	18	10	20					10	
8	SS	18	2	25						
9	SS	18	16	8						
10	SS	18	16	5					15	
~~11~~	~~SS~~	~~1~~	~~1~~	~~Bouncing~~						
									20	
									25	
									30	

Description

FILL - SILT, LITTLE CLAY, TRACE SAND AND LIMESTONE PIECES, Brown

Possible Natural Below 5.5'

(13.2)

SILT, TRACE CLAY AND SAND, Gray

(16.5) LIMESTONE @ 16.1'

Bottom of Boring @ 16.5'

Auger Refusal @ 16.5'

19.5' PVC and Screen Set 2/14/81

Hole redrilled 2/14/81.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			Terracon Consultants, Inc.	BORING STARTED	2/9/81
W.L.	W.S. OR W.D.	A.B.	Cedar Rapids Davenport Des Moines, IA	BORING COMPLETED	2/9/81
W.L.	B.C.R.	A.C.R.	Kansas City Wichita, KS	RIG Mobile B53	FOREMAN JAF
W.L.				APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-7

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS										
1	SS	18	6	60/5''							
2	SS	18	18	30							FILL - SILT, TRACE CLAY WITH LIMESTONE PIECES, Brown
3	SS	18	16	23					5		
4	SS	18	18	30							
5	SS	18	10	52							
6	SS	18	10	37					10		
7	SS	18	4	42/4''							(11.5)
8	SS	18	4	11							CLAYEY SILT, TRACE SAND, Brown
9	SS	18	3	8							(15.0)
10	SS	18	18	4					15		(16.1) CLAYEY SILT, TRACE SAND, Gray
11	SS	18	8	20/2''							(17.3) WEATHERED LIMESTONE, Gray
									20		Bottom of Boring @ 17.3'
											Auger Refusal @ 17.3'
									25		20' PVC and Screen Set 2/14/81. Hole redrilled 2/14/81.
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			Terracon Consultants, Inc.	BORING STARTED	2/12/81
W.L.	W.S. OR W.D.	A.B.	Cedar Rapids Davenport Des Moines, IA	BORING COMPLETED	2/12/81
W.L.	B.C.R.	A.C.R.	Kansas City Wichita, KS	RIG Mobile B53	FOREMAN JAF
W.L.				APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-8 & 8D

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDLAE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS										FILL - SILT, TRACE CLAY WITH LIMESTONE RUBBLE, Brown (Red Brown Clayey Silt Layer 5.0' to 6.0') (Numerous Sand Layers) (14.4)
1	SS	18	5	50/5"							
2	SS	18	18	24							
3	SS	18	14	15					5		
4	SS	18	12	55							
5	SS	18	14	21							
6	SS	18	10	15					10		
7	SS	18	12	7							
8	ST	24									
9	SS	18	16	4							CLAYEY SILT, TRACE SAND, Gray (19.7)
10	SS	12	12	3					15		
11	SS	18	17	6							
12	SS	18	18	6							
13	SS	18	9	30/5"					20		
	RB										WEATHERED LIMESTONE, Gray (28.2)
RUN 1	DB	86	86	100% Recovery					25		
									30		Bottom of Boring @ 28.2' 28' PVC and Screen Set 2/17/81. Hole 8D drilled 2/17/81. 10' Screen used.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				
W.L.	W.S. OR W.D.	A.B.	BORING STARTED	2/13/81
W.L.	B.C.R.	A.C.R.	BORING COMPLETED	2/17/81
W.L.	H_2O loss at 21' to 28'		RIG Mobile B53 / FOREMAN JAF	APPROVED TAS / JOB # 780607

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

LOG OF BORING NO. GM-8A

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS										FILL - SILT, TRACE CLAY AND CLAYEY SILT WITH LIMESTONE, Brown
1	ST	12	12						5		(6.0)
											Bottom of Boring @ 6.0'
									10		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS		
W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.	Dry	

Terracon Consultants, Inc.
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Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 2/13/81	
BORING COMPLETED 2/13/81	
RIG Mobile B53	FOREMAN JAF
APPROVED RGG	JOB # 780607

LOG OF BORING NO. GM-8B

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS								5		SILT, TRACE CLAY AND CLAYEY SILT WITH LIMESTONE, Brown
										(8.0)	LIMESTONE CHUNK
									10		Bottom of Boring @ 8.0'
											Auger Refusal @ 8.0'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			Terracon Consultants, Inc.	BORING STARTED 2/17/81	
W.L.	W.S. OR W.D.	A.B.	Cedar Falls Cedar Rapids Davenport	BORING COMPLETED 2/17/81	
W.L.	B.C.R.	A.C.R.	Des Moines, IA	RIG Mobile B53	FOREMAN JAF
W.L.			Kansas City Wichita, KS	APPROVED RGG	JOB # 780607

LOG OF BORING NO. GM-8C

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description
	HS										SILT, TRACE CLAY AND CLAYEY SILT WITH LIMESTONE, Brown
									5		
										(7.0)	LIMESTONE CHUNK
											Bottom of Boring @ 7.0'
									10		Auger Refusal @ 7.0'

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				
W.L.	W.S. OR W.D.	A.B.		
W.L.	B.C.R.	A.C.R.		
W.L.				

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 2/17/81	
BORING COMPLETED 2/17/81	
RIG Mobile B53	FOREMAN JAF
APPROVED RGG	JOB # 780607

LOG OF BORING NO. GM-9

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol
	HS							
1	SS	18	10	40/5''				
2	SS	18	18	45				
3	SS	18	16	12				
4	SS	18	10	91				
5	SS	18	12	21				
6	SS	18	5	17				
7	SS	18	6	54				
8	SS	18	10	15				
9	SS	18	2	10				
10	SS	18	5	7				
11	SS	18	18	9				
12	SS	18	14	30/2''				
	HS							

Depth scale: 5, 10, 15, 20, 25, 30

Depth	Description
(13.2)	SILT, TRACE CLAY, SAND, AND RUBBLE, Dark Brown
(14.8)	SANDY SILT WITH RUBBLE, Dark Brown
(18.6)	CLAYEY SILT, TRACE SAND AND ORGANICS, Gray
(19.5)	WEATHERED LIMESTONE, Gray

Bottom of Boring @ 19.5'

Auger Refusal @ 19.5'

22' PVC and Screen Set 2/14/81

Hole redrilled 2/14/81.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	W.S. OR W.D.	A.B.	
W.L.	B.C.R.	A.C.R.	
W.L.			

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 2/12/81	
BORING COMPLETED 2/12/81	
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-10

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS										12" Crushed Limestone
1	SS	18	18	26							
2	SS	18	4	8							SILT, TRACE CLAY AND SAND, Dark Gray
3	SS	18	18	18					5		
4	SS	18	18	17							
5	SS	18	18	18							(8.7)
6	SS	18	18	10							
7	SS	18	18	10					10		CLAYEY SILT, TRACE SAND, Dark Brown
8	SS	18	10	8							
9	SS	18	18	6							
									15		(15.0)
10	SS	18	18	9							CLAYEY SILT, TRACE SAND, Gray
											(16.5)
11	SS	16	16	25/1"							(17.3) LIMESTONE, Gray
											Bottom of Boring @ 17.3'
									20		Auger Refusal @ 17.3'
											19.5' PVC and screen set 2/14/81.
											Hole redrilled 2/14/81.
									25		
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS		
W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.		

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 2/12/81	
BORING COMPLETED 2/12/81	
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-11

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol
	HS							
1	SS	18	12	10				
2	SS	18	10	9				
3	SS	18	16	11				
4	SS	18	18	12				
5	SS	18	16	8				
6	SS	18	16	8				
7	SS	18	16	11				
8	SS	18	16	8				
9	SS	18	16	11				
10	SS	18	18	7				
11	SS	16	16	30/2"				

Depth: 5, 10, 15, 20, 25, 30

Elevation

Description

CLAYEY SILT, TRACE SAND WITH RUBBLE,
Brown
(4.0)

SILT, TRACE CLAY AND SAND WITH OCCASIONAL SANDY SILT LAYERS,
Dark Brown
(14.0)

CLAYEY SILT, TRACE SAND,
Gray,
LIMESTONE @ 17.0'
(17.4)

Bottom of Boring @ 17.4'

Auger Refusal @ 17.4'

20.5' PVC and Screen Set 2/14/81.

Hole redrilled 2/14/81.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS		
W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.		

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 2/12/81	
BORING COMPLETED 2/12/81	
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-12	
OWNER ALCOA	ARCHITECT-ENGINEER GERAGHTY & MILLER, INC.
SITE RIVERDALE, IOWA	PROJECT NAME ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS										SILT, TRACE SAND, CLAY AND RUBBLE, Brown
1	SS	18	15	13							
2	SS	18	14	13							(3.5)
3	SS	18	5	16					5		SILT, TRACE CLAY AND SAND, Brown
4	SS	18	16	13							(7.5)
5	SS	18	15	9							
6	SS	18	16	10					10		CLAYEY SILT, TRACE SAND, Dark Brown
7	SS	18	18	12							
8	SS	18	8	12							
9	ST	24									(14.0)
									15		(15.4) CLAYEY SILT, TRACE SAND, Gray
10	SS	18	6	30/5"							(16.5) LIMESTONE, Gray
									20		Bottom of Boring @ 16.5'
											Auger Refusal @ 16.5'
									25		19.5' PVC and Screen Set 2/14/81. Hole redrilled 2/14/81.
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				Terracon Consultants, Inc.	BORING STARTED	2/13/81
W.L.	13.0 W.S. OR W.D.	13.0 A.B.		Cedar Rapids Davenport Des Moines, IA	BORING COMPLETED	2/13/81
W.L.	B.C.R.	A.C.R.		Kansas City Wichita, KS	RIG Mobile B53	FOREMAN JAF
W.L.					APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-13

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS										
1	SS	18	18	63							FILL - SILT, LITTLE CLAY AND SAND AND CONCRETE RUBBLE, Brown
2	SS	18	14	24							
3	SS	18	6	6					5		
4	SS	18	4	35/1"							(7.0)
5	SS	18	9	43							FILL - CLAYEY SILT, LITTLE SAND AND CONCRETE RUBBLE, Brown and Dark Brown
6	SS	18	16	40/4"					10		
7	SS	18	7	15							
8	SS	18	18	13							
9	SS	18	16	15							
10	SS	18	12	30/5"					15		
~~11~~	~~SS~~	~~4~~	~~4~~	~~30/4"~~							(16.5) LIMESTONE @ 16.3'
											Bottom of Boring @ 16.5'
									20		Auger Refusal @ 16.5'
											19.5' PVC and Screen Set 2/14/81.
									25		Hole redrilled 2/14/81.
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU. THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	W.S. OR W.D.	A.B.	
W.L.	B.C.R.	A.C.R.	
W.L.			

Terracon Consultants, Inc.
Cedar Rapids · Davenport · Des Moines, IA
Kansas City · Wichita, KS

BORING STARTED 2/13/81	
BORING COMPLETED 2/13/81	
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-14

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS										8" Crushed Limestone
1	SS	18	16	25							FILL - CLAYEY SILT, TRACE SAND WITH CONCRETE RUBBLE, Brown
2	SS	18	18	8							(4.5)
3	SS	18	14	2					5		CLAYEY SILT WITH SAND LAYERS, Dark Brown
4	SS	18	4	2							
5	SS	18	18	8							
6	SS	18	13	12							Gray @ 11.1'
7	SS	18	18	14					10		(11.5) LIMESTONE @ 11.3'
											Bottom of Boring @ 11.5'
									15		Auger Refusal @ 11.5'
									20		14.5' PVC and Screen Set 2/14/81. Hole redrilled 2/14/81.
									25		
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS					
W.L.	7.0'	W.S. OR W.D.	8.0'	A.B.	
W.L.		B.C.R.		A.C.R.	
W.L.					

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 2/13/81	
BORING COMPLETED 2/13/81	
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-15

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, INC.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description
											6'' Crushed Limestone
	HS										(1.5) SILT, TRACE CLAY AND SAND, Brown and Dark Brown
1	SS	18	18	11							
2	SS	18	10	27							
3	SS	18	6	15					5		FILL - CLAYEY SILT, TRACE SAND AND RUBBLE, Brown and Dark Brown
4	SS	18	14	7							
5	SS	18	13	11							
6	SS	18	18	41							(9.6)
7	SS	5	5	4/5''					10		(11.0) WEATHERED LIMESTONE, Gray
											Bottom of Boring @ 11.0'
									15		
											14' PVC and Screen Set 2/14/81.
											Hole redrilled 2/14/81.
									20		
									25		
									30		

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			Terracon Consultants, Inc.	BORING STARTED 2/13/81	
W.L.	W.S. OR W.D.	A.B.	Cedar Rapids Davenport Des Moines, IA	BORING COMPLETED 2/13/81	
W.L.	B.C.R.	A.C.R.	Kansas City Wichita, KS	RIG Mobile B53	FOREMAN JAF
W.L.				APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM-16

OWNER	ARCHITECT-ENGINEER
ALCOA	GERAGHTY & MILLER, Inc.
SITE	**PROJECT NAME**
RIVERDALE, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS								0–7.5		FILL - CLAYEY SILT WITH CONCRETE RUBBLE, Brown and Dark Brown (7.5)
	RB										
RUN 1	DB	94	60	64% Recovery							WEATHERED LIMESTONE, Gray
RUN 2	DB	80	66	83 % Recovery							(23.0)
											Bottom of Boring @ 23.0'

Depth scale: 5, 10, 15, 20, 25, 30

16.5' PVC and Screen Set
10''Screen Used.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS		
W.L.	W.S. OR W.D.	A.B.
W.L.	B.C.R.	A.C.R.
W.L.		

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 2/17/81	
BORING COMPLETED 2/18/81	
RIG Mobile B53	FOREMAN JAF
APPROVED TAS	JOB # 780607

LOG OF BORING NO. GM17

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	GERAGHTY & MILLER INC.
SITE	**PROJECT NAME**
DAVENPORT, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol
	PA							
1	SS	5"	2	40/5"		15.3		
	PA							
2	SS	18	4	10		13.9		
	PA							
3	SS	18	7	20		18.3		
	PA							
4	SS	18	5	10		20.1		
	PA							
5	SS	18	5	37		17.1		
	PA							
6	SS	18	6	7		17.1		
	PA							
7	SS	18	14	12		31.5		ML OL
	PA							
8	SS	18	12	17		30.1	93	CL
	PA							
9	SS	18	12	21		19.1	101	CL

Description

SURFACE ELEVATION 581.0

Elevation	Depth	Description
		FILL, SILT, SAND, LIMESTONE, GRAVEL, RUBBLE & WOOD Dark Gray to Gray Brown
572.0	(9.0)	
		FILL, SANDY SILTY CLAY, TRACE CRUSHED LIMESTONE (OIL SATURATED) Dark Gray to Gray Brown
565.0	(16.0)	
		SANDY SILT, TRACE CLAY & ORGANICS & WOOD (OIL SATURATED) Dark Brown to Dark Gray
562.5	(18.5)	
		CLAYEY SILT, TRACE SAND (OIL SATURATED) Gray Brown
559.5	(21.5)	
		SILTY CLAY WITH SAND SEAMS (RESIDUAL SHALE & SANDSTONE) Gray
558.0	(23.0)	

BOTTOM OF BORING

Set 23' of observation well with 15' of well screen and 8' of 2" O.D. PVC pipe above screen 2.2' of riser pipe above ground. Annulus filled with sand to 7', sealed with 1' of bentonite, and grouted with protective pipe to surface.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	6.5 W.S. OR W.D.		A.B.
W.L.	B.C.R.		A.C.R.
W.L.			

Terracon Consultants, Inc.
Cedar Falls Cedar Rapids Davenport
Des Moines, IA
Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED	2-11-82		
BORING COMPLETED	2-11-82		
RIG	BOMB	FOREMAN	JAF
APPROVED	GKO	JOB #	781580-1

LOG OF BORING NO. GM18

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	GERAGHTY & MILLER INC.
SITE	PROJECT NAME
DAVENPORT, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											SURFACE ELEVATION 579.2
	PA										FILL, SILTY CLAY, TRACE SAND AND GRAVEL, RUBBLE & WOOD Dark Gray
1	SS	18	8	20		18.6					
	PA										
2	SS	3	2	55/3"		25.2			5	574.2	(5.0)
	PA										FILL, SANDY CLAYEY SILT, TRACE CRUSHED LIMESTONE (OIL SATURATED) Dark Brown, Dark Gray, Red Brown
3	SS	18	10	6		24.6					
	PA										
4	SS	18	5	8		17.1			10		
	PA										
5	SS	18	10	6		19.9					
	PA										
6	SS	18	10	8		29.3			15	563.2	(16.0)
	PA										SANDY SILT, TRACE CLAY & ORGANICS (OIL SATURATED) Dark Brown to Dark Gray
7	SS	18	10	12		16.7		ML OL		560.7	(18.5)
	PA										SILTY CLAY W/SAND SEAMS (RESIDUAL SHALE & SANDSTONE) Gray (Chemical Odor)
8	SS	18	18	12		26.4		CL CH	20		
	PA										
9	SS	18	18	63		31.3	78	CL CH		556.2	(23.0)
									25		BOTTOM OF BORING Power Auger Refusal @ 23' on sandstone (field classification) Set 23' of well casing consisting of 15' of well screen with 8' of 2" O.D PVC pipe above 2.9' feet of riser pipe above ground. Annulus packed with sand to 7' from surface, sealed with 1' of bentonite, and then protective pipe grouted in.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	22.5 W.S. OR W.D.	22.5	A.B.
W.L.	B.C.R.		A.C.R.
W.L.			

Terracon Consultants, Inc.
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Des Moines, IA
Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED	2-11-82
BORING COMPLETED	2-11-82
RIG BOMB	FOREMAN JAF
APPROVED GKO	JOB #781580-1

LOG OF BORING NO. GM19

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	GERAGHTY & MILLER INC.
SITE	**PROJECT NAME**
DAVENPORT, IOWA	ALCOA MONITORING WELLS

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											SURFACE ELEVATION 580.6
	PA										
1	SS	18	6	48		14.7					FILL, SANDY CLAYEY SILT, RUBBLE, WOOD & CRUSHED LIMESTONE Dark Gray to Dark Brown
	PA										
2	SS	18	2	27		14.9			5	574.6 (6.0)	
	PA										
3	SS	18	4	7		18.8					
	PA										
4	SS	18	4	3		24.6			10		FILL, CLAYEY SILT, TRACE SAND AND CRUSHED LIMESTONE (OIL SATURATED) Dark Gray to Gray
	PA										
5	SS	18	4	7		17.1					
	PA										
6	SS	18	6	7		17.8			15		
	PA										
7	SS	18	4	9		21.1				562.1 (18.5)	
	PA										
8	SS	18	10	10		23.2	95	OL ML	20	559.6 (21.0)	SANDY SILT, TRACE CLAY, ORGANICS (OIL SATURATED) Dark Brown to Gray
	PA										
9	SS	18	14	15		17.8		CL CH			SILTY CLAY WITH THIN SAND SEAMS (RESIDUAL CLAY SHALE AND SANDSTONE) Gray to Gray Green & White (Chemical Odor)
	PA										
10	SS	18	14	63		23.4		CL CH	25	555.1 (25.5)	
											BOTTOM OF BORING Set 25' of observation well in ground with 15' of well screen and 10' of 2" O.D. PVC pipe above screen. 3' of riser pipe above ground. Annulus packed with sand to 9' from surface, sealed with 1' of bentonite, and then grouted in protective pipe.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	8.0' W.S. OR W.D.	8.0'	A.B.
W.L.	B.C.R.		A.C.R.
W.L.			

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BORING STARTED	2-11-82
BORING COMPLETED	2-11-82
RIG BOMB	FOREMAN JAF
APPROVED GKO	JOB #781580-1

LOG OF BORING NO. GM20

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	GERAGHTY & MILLER
SITE	PROJECT NAME
DAVENPORT WORKS, RIVERDALE, IOWA	PCB LAGOON MONITORING

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											FILL: SANDY CLAYEY SILT
									5		Gray
	HS										
									10		
											(13.0')
											(14.5') LIMESTONE, WEATHERED, Gray
									15		BOTTOM OF BORING @ 14.5'
											Classification of soil materials estimated from disturbed auger tailings. See attached documentation for well details.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	Dry W.S. OR W.D.	Dry	A.B.
W.L.	B.C.R.		A.C.R.
W.L.			

Terracon Consultants, Inc.
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Oklahoma City Tulsa, OK

BORING STARTED	9-27-84
BORING COMPLETED	9-27-84
RIG Mobile 2	FOREMAN RAF
APPROVED DEK	JOB # 784568

LOG OF BORING NO. GM21

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	GERAGHTY & MILLER
SITE	PROJECT NAME
DAVENPORT WORKS, RIVERDALE, IOWA	PCB LAGOON MONITORING

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											FILL: SANDY CLAYEY SILT AND CONCRETE RUBBLE Brown
									5		(5.0')
	HS										FILL: SANDY CLAYEY SILT WITH OCCASIONAL RUBBLE
									10		Gray
									15		(16.5')
											LIMESTONE, WEATHERED, Gray (18.0')
									20		BOTTOM OF BORING @ 18.0'
											Classification of soil materials estimated from disturbed auger tailings. See attached documentation for well details.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES. IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L. Dry	W.S. OR W.D.	Dry	A.B.
W.L.	B.C.R.		A.C.R.
W.L.			

Terracon Consultants, Inc.
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Des Moines, IA
Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED 9-28-84	
BORING COMPLETED 9-28-84	
RIG Mobile 2	FOREMAN RAF
APPROVED DEK	JOB # 784568

LOG OF BORING NO. GM22

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	GERAGHTY & MILLER
SITE	**PROJECT NAME**
DAVENPORT WORKS, RIVERDALE, IOWA	PCB LAGOON MONITORING

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description
											FILL: SANDY CLAYEY SILT AND CONCRETE RUBBLE Brown
									5		(5.0')
	HS										FILL: SANDY CLAYEY SILT AND OCCASIONAL CONCRETE RUBBLE Gray
									10		(12.0')
									15		SANDY SILTY CLAY, TRACE GRAVEL Gray Glacial Till
											(17.5')
											(17.7') SEE NOTE #1
									20		BOTTOM OF BORING @ 17.7'
											Classification of soil materials estimated from disturbed auger tailings. See attached documentation for well details.
											NOTE #1: LIMESTONE, SLIGHTLY WEATHERED, Gray

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES. IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	17.5' W.S. OR W.D.	17.5'	A.B.
W.L.	B.C.R.		A.C.R.
W.L.			

Terracon Consultants, Inc.
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Kansas City Wichita, KS
Oklahoma City Tulsa, OK

BORING STARTED	9-27-84		
BORING COMPLETED	9-27-84		
RIG	Mobile 2	FOREMAN	RAF
APPROVED	DEK	JOB #	784568

LOG OF BORING NO. GM23

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	GERAGHTY & MILLER
SITE	**PROJECT NAME**
DAVENPORT WORKS, RIVERDALE, IOWA	PCB LAGOON MONITORING

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	HS								0–11.0		FILL: SANDY CLAYEY SILT AND CONCRETE RUBBLE Brown (11.0')
									11.0–17.5		SANDY CLAYEY SILT Gray (17.5')
											~~(18.0') SEE NOTE #1~~
											BOTTOM OF BORING @ 18.0'

Three attempts made at 3 locations to approximate depths of 1.5' prior to penetration of concrete rubble.

Classification of soil materials estimated from disturbed auger tailings. See attached documentation for well details.

NOTE #1:

LIMESTONE, WEATHERED

Gray

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	17.5 W.S. OR W.D.	17.5	A.B.
W.L.	B.C.R.		A.C.R.
W.L.			

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Des Moines, IA
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Oklahoma City Tulsa, OK

BORING STARTED 9-27-84	
BORING COMPLETED 9-27-84	
RIG Mobile 2	FOREMAN RAF
APPROVED DEK	JOB # 784568

LOG OF BORING NO. 1

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS; RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

GROUND SURFACE ELEVATION = 580.3

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description
	PA										FILL-SILT AND CONCRETE RUBBLE, MIXED WITH CEMENT DUST
1	SS	18	11	13							Brown to Gray Brown
	PA									576.8	(3.5)
									5		FILL-CEMENT DUST, UNMIXED, Gray
2	SS	18	13	4						574.3	(6.0)
	PA										FILL-CEMENT DUST MIXED W/OIL,
3	SS	18	14	6						572.3	(8.0) Black
	PA								10		FILL-SILT, TRACE CLAY, MIXED W/ CEMENT DUST
4	SS	18	14	8							-Gray to Dark Brown -Chemical Odor
	PA										-Layers of Unmixed Cement Dust Present
5	SS	18	12	4					15	562.8	(15.0)
	PA										FILL-SILT, MIXED WITH OIL
6	SS	18	12	*							Black (17.5)
									20		BOTTOM OF BORING @ 17.5

NOTE: All samples given to client in field.

* Split-spoon sampler sinking under its own weight

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	15.0	W.S. OR W.D.	A.B.
W.L.		B.C.R.	A.C.R.
W.L.	Cave-in @ 7.0' A.B.		

Terracon Consultants, Inc.
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Kansas City Wichita, KS

BORING STARTED	12-14-81		
BORING COMPLETED	12-14-81		
RIG	CME 55	FOREMAN	SM
APPROVED	RKL	JOB #	781580

LOG OF BORING NO. 2 (3rd location)

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS ; RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description GROUND SURFACE ELEVATION = 580.3
	PA										FILL-SILT AND ROCK RUBBLE, MIXED W/CEMENT DUST, Brown to Gray Brown
1	SS	18	11	12						577.3	(3.0)
	PA										FILL-SILT, MIXED WITH CEMENT DUST Brown to Gray Brown
2	SS	18	16	5					5		
	PA									573.3	(7.0)
3	SS	18	5	4							FILL-SILT, MIXED WITH CEMENT DUST AND OIL - Dark Brown
	PA								10		- Occasional Layers of Concrete Rubble
4	SS	18	5	3						568.3	(12.0) - Strong Chemical Odor @ 10.0
	PA										SANDY SILTY CLAY, TRACE GRAVEL -Dark Brown
5	SS	18	10	4					15	565.8	(14.5) -Chemical Odor

BOTTOM OF BORING @ 14.5

NOTE: All samples given to client in the field

NOTE: Location of borings moved three times:
1st location-auger refusal @ 7.5

2nd Location-auger refusal @ 7.0

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS					
V.L.	12.0	W.S. OR W.D.	13.0	A.B.	
W.L.		B.C.R.		A.C.R.	
W.L.	Boring Destoryed By Construction				

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 12-14-81	
BORING COMPLETED 12-14-81	
RIG CME 55	FOREMAN SM
APPROVED RKL	JOB # 781580

LOG OF BORING NO. 3 (3rd location)

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE DAVENPORT WORKS : RIVERDALE, IOWA	**PROJECT NAME** WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION = 580.3
	PA										FILL-SILT MIXED WITH CEMENT DUST - Brown (Fill mixtures consists primarily of cement dust)
1	SS	18	16	16							
	PA										
2	SS	18	16	3					5		
										574.3	(6.0)
	PA										FILL-SANDY SILT (OIL SATURATED) AND POORLY MIXED WITH CEMENT DUST, -Brown to Black -Pocket of Oil @ 7' to 8.5' -Few layers of Unmixed Cement Dust
3	SS	18	6	4							
	PA								10		
4	SS	18	9	14							
	PA										
5	SS	18	10	4					15		(COBBLES & GRAVEL @ 15 to 16.5')
6	SS	18	*	*						563.8	(16.5) Limestone, Brown @ 16.5'

NOTE: All samples given to client in the field.

* Split-spoon sampler bouncing

BOTTOM OF BORING @ 16.5

NOTE: Location of boring moved three times:
1st location-auger refusal @ 6.5
2nd location-auger refusal @ 4.0

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			Terracon Consultants, Inc.	BORING STARTED	
W.L.	W.S. OR W.D.	A.B.	Cedar Rapids Davenport Des Moines, IA	BORING COMPLETED	
W.L.	B.C.R.	A.C.R.	Kansas City Wichita, KS	RIG	FOREMAN
W.L.				APPROVED	JOB #

LOG OF BORING NO. 4

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS : RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION = 576.3
1	ST	24	12			15.9	111.5				FILL-MIXTURE OF SANDY CLAYEY SILT AND RUBBLE
2	ST	24	10			20.8			5		-Dark Brown -Chemical Odor Begins @ 5.0
3	AS	12									
	PA										
4	AS	12									(9.0)
	PA								10		FILL-MIXTURE OF CLAYEY SILT AND RUBBLE FILL AND OIL -Dark Brown to Black
5	AS	24								563.3	(13.0) Limestone @ 13.0'
									15		BOTTOM OF BORING @ 13.0

NOTE: Samples 3,4,and 5 given to client in field.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L. 3.5	W.S. OR W.D.	None	A.B.
W.L.	B.C.R.		A.C.R.
W.L. 4.0 @ 24 hrs.			

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 12-15-81	
BORING COMPLETED 12-15-81	
RIG CME 55	FOREMAN SM
APPROVED RKL	JOB # 781580

LOG OF BORING NO. 5

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS; RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION = 576.0
1	ST	24	18			27.1	90.5				FILL-MIXTURE OF SILTY CLAY, TRACE SAND AND RUBBLE FILL Brown to Red/Brown
2	ST	12	8			27.9				572.0	(4.0)
	PA								5		FILL-MIXTURE OF SILT, GRAVEL, RUBBLE Dark Brown
3	AS	24									
										576.0	(9.0)
	PA								10		CLAYEY SILT, TRACE SAND Dark Brown
4	AS	24								563.0	(13.0)Weathered Limestone @ 13.0'
									15		BOTTOM OF BORING @ 13.0

NOTE: Samples 3 & 4 given to client in field

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS						
W.L.	None	W.S. OR W.D.	None	A.B.		
W.L.		B.C.R.		A.C.R.		
W.L.	9.0' @ 24 hr.					

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 12-15-81	
BORING COMPLETED 12-15-81	
RIG CME 55	FOREMAN SM
APPROVED DKL	JOB # 781580

LOG OF BORING NO. 6

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE DAVENPORT WORKS : RIVERDALE, IOWA	PROJECT NAME WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION = 575.9
1	ST	12	10			15.0	113.4				FILL-SILTY CLAY, TRACE SAND, TRACE GRAVEL WITH OCCASIONAL RUBBLE, Brown to Red/Brown
	PA								5	570.9	(5.0)
											CLAYEY SILT, TRACE SAND, Gray/Brown Chemical Odor
2	AS	24	*							566.9	(9.0)
	PA								10		CLAYEY SILT, TRACE SAND, (SATURATED WITH OIL) Dark Brown
3	AS	24	*							562.9	(13.0)
	PA										SANDY SILT, Greenish Gray
4	AS	12	*						15	560.9	(15.0)(Chemical Odor)
											BOTTOM OF BORING @ 15.0
									20		

NOTE: Samples 2, 3 and 4 were given to client in field

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				
W.L. 3.5	W.S. OR W.D.	2.0	A.B.	
W.L.	B.C.R.		A.C.R.	
W.L. 2.4 @ 24 hr.				

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 12-15-81	
BORING COMPLETED 12-15-81	
RIG CME 55	FOREMAN SM
APPROVED RKL	JOB # 781580

LOG OF BORING NO. 7

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS; RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION=578.7
1	ST	24	4		*9000+	15.3					FILL-CLAYEY SILT, LITTLE GRAVEL, TRACE SAND WITH OCCASIONAL RUBBLE, Dark Brown
2	ST	24	12		*4200	16.3	106.4				
	PA								5		
3	AS	12									
	PA								10	567.7	(11.0)
4	AS	24								565.7	NOTE 1 (13.0)
											BOTTOM OF BORING @ 13.0
									15		
									20		

* Calibrated Hand Penetrometer

NOTE: Sample # 3 and 4 given to client in field

NOTE 1

FILL-CLAYEY SILT, LITTLE GRAVEL TRACE SAND, WITH CONCRETE RUBBLE AND OIL

Dark Brown

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L. None	W.S. OR W.D.	None	A.B.
W.L.	B.C.R.		A.C.R.
W.L. None @ 24 Hr			

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED	12-15-81		
BORING COMPLETED	12-15-81		
RIG	CME 55	FOREMAN	SM
APPROVED	RKL	JOB #	781580

LOG OF BORING NO. 8

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS ; RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION = 577.8
1	ST	6	6			19.1	102.6				FILL-CLAYEY SILT, TRACE SAND WITH OCCASIONAL RUBBLE Gray/Brown to Dark Brown
	PA										
2	ST	12	6			12.0					
	PA								5		
3	AS	24								568.8	(9.0)
	PA								10		FILL-CLAYEY SILT, TRACE SAND WITH RUBBLE AND OIL Brown to Dark Brown Strong Chemical Odor
										555.8	(13.0)
									15		BOTTOM OF BORING @ 13.0

NOTE: Sample #3 given to client in field

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS						
W.L.	6.0	W.S. OR W.D.	4.0	A.B.	BORING STARTED	12-15-81
W.L.		B.C.R.		A.C.R.	BORING COMPLETED	12-15-81
W.L.	5.2 @ 24 hr.				RIG CME 55	FOREMAN SM
					APPROVED RKL	JOB # 781580

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

LOG OF BORING NO. 9

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS : RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION=581.8
1	ST	24	15		9000+	19.2	109.9				FILL- SANDY CLAYEY SILT WITH OCCASIONAL RUBBLE Dark Brown to Dark Gray
2	ST	24	5		1500						
									5	576.8	(5.0)
	PA										
3	AS	12									SILTY CLAY, TRACE SAND, TRACE GRAVEL Brown to Gray Chemical Odor
	PA								10		
4	AS	24									
									15	566.8	(15.0)
											BOTTOM OF BORING @ 15.0

NOTE: Samples 3 and 4 given to client in field

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS					
W.L.	9.0	W.S. OR W.D.	8.0	A.B.	
W.L.		B.C.R.		A.C.R.	
W.L.	4.0 @ 24 hr				

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED	12-15-81		
BORING COMPLETED	12-15-81		
RIG	CME 55	FOREMAN	SM
APPROVED	RKL	JOB #	781580

LOG OF BORING NO. 16

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS: RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION = 577.8
1	ST	12	0								FILL-SANDY SILT, TRACE CLAY, WITH CINDERS AND RUBBLE Dark Brown
	PA										
2	ST	18	6			39.1					
									5	572.8	(5.0)
	PA										SILTY CLAY, TRACE SAND AND GRAVEL, WITH OCCASIONAL SAND SEAMS Gray to Dark Gray Strong Chemical Odor Small lenses of oil below 8.0
3	AS										
	PA								10		
4	AS										
									15	562.8	(15.0)
											BOTTOM OF BORING @ 15.0

NOTE: Samples 3 and 4 given to client in field

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				
W.L.	4.0	W.S. OR W.D.	12.0	A.B.
W.L.		B.C.R.	-	A.C.R.
W.L.	3.0 @ 24 hrs			

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 12-15-81	
BORING COMPLETED 12-15-81	
RIG CME 55	FOREMAN SM
APPROVED R KL	JOB # 781580

LOG OF BORING NO. 1:

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS : RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description GROUND SURFACE ELEVATION = ~~587.0~~ 578
1	ST	18	3			17.1					FILL-MIXTURE OF CLAYEY SILT, TRACE SAND AND SILTY CLAY, WITH OCCASIONAL RUBBLE, Dark Brown and Dark Gray Chemical Odor below 2.5
2	ST	12	4			22.3					
	PA								5		
3	AS	12	*							569.5(8.5)	
										569.0	NOTE 1
									10		BOTTOM OF BORING @ 9.0

NOTE: Sample #3 given to client in field

NOTE 1:

FILL - CONCRETE RUBBLE
Dense
Massive

NOTE 2:

Boring location moved and re-drilled due to obstructing concrete at 8.0' at first location.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				
W.L.	2.0	W.S. OR W.D.	None	A.B.
W.L.		B.C.R.		A.C.R.
W.L.	None @ 24 hr.			

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED	12-15-81		
BORING COMPLETED	12-15-81		
RIG	CME 55	FOREMAN	SM
APPROVED	RKL	JOB #	781580

LOG OF BORING NO. [illegible]

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS:RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description GROUND SURFACE ELEVATION = 580.8
1	ST	18	10			19.2	106.9				FILL-MIXTURE OF SANDY SILT, AND SILTY CLAY W/OCCASIONAL RUBBLE, Reddish Brown to Dark Brown
	PA								5		
2	AS	60	*						10		
										567.8	(13.0)
									15		BOTTOM OF BORING @ 13.0

NOTE: Sample 2 given to client in field

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS					BORING STARTED 12-15-81	
W.L. 12.0	W.S. OR W.D.	5.0	A.B.	Terracon Consultants, Inc.	BORING COMPLETED 12-15-81	
W.L.	B.C.R.		A.C.R.	Cedar Rapids Davenport Des Moines, IA	RIG CME 55	FOREMAN SM
W.L. 5.0 @ 24 hr.				Kansas City Wichita, KS	APPROVED RKL	JOB # 781580

LOG OF BORING NO. [illegible]

OWNER	ARCHITECT-ENGINEER
[illegible] COMPANY OF AMER[illegible]	
SITE	**PROJECT NAME**
DAVENPORT WORKS: RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION = 580.9
1	ST	12	8			14.8	109.1				FILL- SANDY CLAYEY SILT, TRACE GRAVEL AND CINDERS WITH OCCASIONAL RUBBLE Brown to Dark Brown
	PA										
									5	575.9	(5.0)
											FILL-SILTY CLAY, LITTLE SAND, TRACE GRAVEL WITH OCCASIONAL RUBBLE Dark Brown Strong Chemical Odor
2	AS	12									
	PA								10		
3	AS	12								567.9	(13.0)
									15		BOTTOM OF BORING @ 13.0

NOTE: Sample 2 and 3 given to client in field.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS						BORING STARTED	12-15-81
W.L.	11.0	W.S. OR W.D.	12.0	A.B.	Terracon Consultants, Inc.	BORING COMPLETED	12-15-81
W.L.		B.C.R.		A.C.R.	Cedar Rapids Davenport Des Moines, IA	RIG CME 55	FOREMAN SM
W.L.	4.0 @ 24 hr.				Kansas City Wichita, KS	APPROVED RKL	JOB = 781580

LOG OF BORING NO. [illegible]

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS: RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION = 577.0
1	ST	18	12		*5000	14.9	106.4				FILL- SANDY CLAYEY SILT, TRACE GRAVEL W/OCCASIONAL RUBBLE
2	ST	6	3		*5000	15.9	113.			573.0	(4.0) Brown to Reddish Brown
	PA								5		SILTY CLAY, LITTLE SAND, TRACE GRAVEL Dark Gray Strong Chemical Odor
3	AS	24									
	PA								10		
4	AS	36								565.0	(12.0)
										564.0	(13.0) WEATHERED LIMESTONE
									15		BOTTOM OF BORING @ 13.0

* Calibrated Hand Penetrometer

NOTE: Sample 3 and 4 given to client in field.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				
W.L.	None	W.S. OR W.D.	None	A.B.
W.L.		B.C.R.		A.C.R.
W.L.	None @ 24 hr.			

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 12-15-81	
BORING COMPLETED 12-15-81	
RIG CME 55	FOREMAN SM
APPROVED RKL	JOB # 781580

LOG OF BORING NO. 15

OWNER	ARCHITECT-ENGINEER
[illegible] COMPANY OF AMERICA	
SITE	**PROJECT NAME**
DAVENPORT WORKS : RIVERDALE, IOWA	WASTE LAGOON STABILIZATION

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											GROUND SURFACE ELEVATION = 578.1
1	ST	24	18		*4000	20.1	101.4				FILL-CLAYEY SILT, GRAVEL, CINDERS, CONCRETE FRAGMENTS, TRACE SAND Dark Brown
2	ST	24	20		*4000	18.9	106.0		5	573.6	(4.5)
3	ST	24	24								SANDY SILTY CLAY, TRACE GRAVEL (OIL SATURATED) Gray to Dark Gray Thin gravel layer @ 10.0
									10		
4	ST	24							15	563.1	(15.0)
											BOTTOM OF BORING @ 15.0

* Calibrated Hand Penetrometer

NOTE: Sample 3 given to client in field.

NOTE: Boring location moved and redrilled due to obstruction @ 7.5 at first boring location.

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL AND ROCK TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L. 6.5	W.S. OR W.D.	4.5	A.B.
W.L.	B.C.R.		A.C.R.
W.L. 5.0 @ 24 hr.			

Terracon Consultants, Inc.
Cedar Rapids Davenport Des Moines, IA
Kansas City Wichita, KS

BORING STARTED 12-15-81	
BORING COMPLETED 12-15-81	
RIG CME 55	FOREMAN SM
APPROVED RKL	JOB # 781580

Geraghty & Miller, Inc.

WELL LOG

PROJECT Alcoa, Davenport DATE 6/14/84 SHEET 1 OF 1

LOCATION A DRILLING CONTRACTOR Albrecht

WELL NUMBER Shallow DRILLING METHOD Air Rotary

SAMPLE DESCRIBED BY John R. Mildenberger SAMPLING METHOD Cuttings

SAMPLE NUMBER	SAMPLE DESCRIPTION	DRILLING COMMENTS	DEPTH INTERVAL (FEET)	THICKNESS (FEET)
	Sand, silt and limestone fragments, moist, brown, glass, roots, rebar, fill		0-9.5	9.5
	Limestone, float or fill	Hard Drilling	9.5-11	1.5
	Silt, some fine sand and organics, very moist, dark brown		11-13	2
	Same (oil odor)		13-16	3
	Clay, some silt, very moist, green, plastic		16-17	1

Geraghty & Miller, Inc.

WELL LOG

PROJECT Alcoa, Davenport DATE 6/13/84 SHEET 1 OF 1

LOCATION A DRILLING CONTRACTOR Albrecht

WELL NUMBER Intermediate DRILLING METHOD Air Rotary

SAMPLE DESCRIBED BY John R. Mildenberger SAMPLING METHOD Cuttings

SAMPLE NUMBER	SAMPLE DESCRIPTION	DRILLING COMMENTS	DEPTH INTERVAL (FEET)	THICKNESS (FEET)
	Sand, silt and limestone fragments, moist, brown, debris, metal, fill	Note: Driving casing compressed formation, depths may be distorted in the overburdened	0-16	16
	Silt and clay, moist, brown, little organics		16-17	1
	Silt and clay, moist to very moist, black, oil odor		17-18	1
	Silt and clay, moist, greenish grey	Rock encountered at 19 ft.	18-19	1
	Limestone, microcyrstalline, occasionally vesicular, light brown to light grey, low permeability except fair where fractured or vesicular, pyrite	Small amount of water encountered at 29 ft.	19-49.5	30.5
	Shale, grey to green, friable, calcareous, low permeability, dry		49.5-55	5.5
	Limestone, microcrystalline, occasionally vesicular and fossilferous, light grey, low permeability except good where fractured or vesiclar, pyrite, crystals well developed in vesicles, occasional thin blue-green shale seams		55-150	95

Geraghty & Miller, Inc.

WELL LOG

PROJECT Alcoa, Davenport DATE 6/14/84 SHEET 1 OF 1

LOCATION A DRILLING CONTRACTOR Albrecht

WELL NUMBER Deep DRILLING METHOD Air Rotary

SAMPLE DESCRIBED BY John R. Mildenberger SAMPLING METHOD Cuttings

SAMPLE NUMBER	SAMPLE DESCRIPTION	DRILLING COMMENTS	DEPTH INTERVAL (FEET)	THICKNESS (FEET)
	Sand, silt and limestone fragments, moist, brown, metal, etc., fill		0-11	11
	Silt and clay, moist, brown		11-14	3
	Silt and clay, moist to very moist, black, oil odor		14-15.5	1.5
	Clay, some silt, moist green, plastic		15.5-19	3.5
	Limestone, microcrystalline, light grey, pyrite	Rock encountered at 19 ft.	19-28	9
	Shale, grey to green, friable, calcareous	Small amount of water encountered at 30 ft.	28-34	6
	Limestone, microcyrstalline, occasionally vesicular, light grey, low permeability except fair where fractured or vesicular, pyrite	Water production increases to 1 GPM at 44 ft.	34-50	16
	Shale, grey to green, friable, calcareous, low permeability, dry		50-55	5
	Limestone, microcrystalline, occasionally vesicular and fossilferous, grey to white, low permeability except good where fractured or vesiclar, pyrite, crystals well developed in vesicles, occasional thin blue-green shale seams	Water production from fractures at 64 ft., 80 ft., 130-150 ft., 200 ft. and 210 ft.	55-300	245

Geraghty & Miller, Inc.

WELL LOG

PROJECT Alcoa, Davenport DATE 6/06/84 SHEET 1 OF 1

LOCATION B DRILLING CONTRACTOR Albrecht

WELL NUMBER Intermediate DRILLING METHOD Air Rotary

SAMPLE DESCRIBED BY John R. Mildenberger SAMPLING METHOD Cuttings

SAMPLE NUMBER	SAMPLE DESCRIPTION	DRILLING COMMENTS	DEPTH INTERVAL (FEET)	THICKNESS (FEET)
	Silty, some fine sand, little clay, limestone fragments, trace glass fragments and organics, moist, dark brown, fill		0-5	5
	Silt and clay, moist, brown, plastic		5-7.5	2.5
	Clay and silt, trace limestone fragments, moist, pale green		7.5-8.5	1
	Limestone, microcrystalline, occasionally vesicular, light grey, low permeability except fair where fractured or vesicular, pyrite	Rock encountered at 8.5 ft. Small amount of water encountered at 40 ft.	8.5-43	34.5
	Shale, grey, friable, calcareous, low permeability, dry		43-55	12
	Limestone, microcyrstalline, occasionally vesicular and fossiliferous, light grey, low permeability except good where fractured or vesicular, pyrite, crystals well developed in vesicles, occasional thin blue-green shale seams	Water production from fractures at 73 ft. 117 to 150 ft.	55-150	95

Geraghty & Miller, Inc.

WELL LOG

PROJECT Alcoa, Davenport DATE 6/07/84 SHEET 1 OF 1

LOCATION B DRILLING CONTRACTOR Albrecht

WELL NUMBER Deep DRILLING METHOD Air Rotary

SAMPLE DESCRIBED BY John R. Mildenberger SAMPLING METHOD Cuttings

SAMPLE NUMBER	SAMPLE DESCRIPTION	DRILLING COMMENTS	DEPTH INTERVAL (FEET)	THICKNESS (FEET)
	Silty, some fine sand, little clay, limestone fragments, trace glass fragments and organics, moist, dark brown, fill		0-5	5
	Silt and clay, moist, brown, plastic		5-7	2
	Clay and silt, trace limestone fragments, moist, pale green		7-8	1
	Limestone, microcrystalline, occasionally vesicular, light grey, low permeability except fair where fractured or vesicular, pyrite, occasional thin blue-green shale seams	Rock encountered at 8 ft. Small amount of water encountered at 25 ft.	8-43	35
	Shale, greyish green, friable, calcareous, low permeability, dry		43-59	16
	Limestone, microcyrstalline, occasionally vesicular and fossilferous, light grey, low permeability except good where fractured or vesicular, pyrite, crystals well developed in vesicles, occasional thin blue-green shale seams	Water production from fractures at 61 ft. 70 to 90 ft., 120 to 200 ft., large fracture at 160 to 162	59-300	241

Geraghty & Miller, Inc.

WELL LOG

PROJECT Alcoa, Davenport DATE 5/30/84 SHEET 1 OF 2

LOCATION C DRILLING CONTRACTOR Albrecht

WELL NUMBER Intermediate DRILLING METHOD Air Rotary

SAMPLE DESCRIBED BY John R. Mildenberger SAMPLING METHOD Cuttings

SAMPLE NUMBER	SAMPLE DESCRIPTION	DRILLING COMMENTS	DEPTH INTERVAL (FEET)	THICKNESS (FEET)
	Topsoil		0-1	1
	Silt and clay, trace fine sand moist, brown		1-8	7
	Clay, little silt, moist to very moist, reddish brown, plastic		8-9.5	1.5
	Clay, little to some silt, moist grey		9.5-10	0.5
	Silt, some clay, trace fine sand, moist to dry, light yellow brown to brown		10-11.5	1.5
	Limestone, microcrysalline, very light grey to white, pyrite	Rock encountered at 11.5 ft.	11.5-12.5	1
	Shale, dry, grey, friable, calcareous, low permeability		12.5-14.5	2
	Limestone, microcyrstalline, occasionally vesicular, grey to white, low permeability except fair where fractured or vesicular, pyrite well developed in vesicles	Water encountered at 20 ft. production increases as fractures encountered at 23.5 ft. and 34 ft.	14.5-36	21.5
	Shale, grey, friable, calcareous, low permeability, some fine sand		36-50	14

Geraghty & Miller, Inc.

WELL LOG

PROJECT Alcoa, Davenport DATE 5/30/84 SHEET 2 OF 2

LOCATION C DRILLING CONTRACTOR Albrecht

WELL NUMBER Intermediate DRILLING METHOD Air Rotary

SAMPLE DESCRIBED BY John R. Mildenberger SAMPLING METHOD Cuttings

SAMPLE NUMBER	SAMPLE DESCRIPTION	DRILLING COMMENTS	DEPTH INTERVAL (FEET)	THICKNESS (FEET)
	Limestone, microcrystalline, occasionally vesicular and fossilferous, grey to white, low permeability except good where fractured or vesiclar, pyrite, crystals well developed in vesicles, occasional thin blue-green shale seams	Water production from fractures at 55 ft., 64.5 ft. Fractures below this depth were difficult to recognize	50-150	100

Geraghty & Miller, Inc.

WELL LOG

PROJECT Alcoa, Davenport DATE 5/30/84 SHEET 1 OF 1

LOCATION C DRILLING CONTRACTOR Albrecht

WELL NUMBER Deep DRILLING METHOD Air Rotary

SAMPLE DESCRIBED BY John R. Mildenberger SAMPLING METHOD Cuttings

SAMPLE NUMBER	SAMPLE DESCRIPTION	DRILLING COMMENTS	DEPTH INTERVAL (FEET)	THICKNESS (FEET)
	Topsoil		0-1	1
	Silt and clay, trace fine sand and organics, moist, dark		1-8	7
	Silt and fine sand, little organics, dry to moist, dark brown		8-12.5	4.5
	Sand, fine, some silt, shale and limestone fragments, dry light greyish brown		12.5-13.5	1
	Shale, dry, greyish-green, friable, calcareous, low permeability	Rock encountered at 13.5 ft.	13.5-21	7.5
	Limestone, grey, friable, calcareous, low permeability	Water encountered at 40 ft.	21-45	24
	Shale, dry, grey, friable, calcareous, low permeability		45-49	4
	Limestone, microcyrstalline, occasionally vesicular and fossilferous, grey to white, low permeability except good where fractured or vesicular, pyrite, crystals well developed in vesicles, occasional thin blue-green shale seams	Water production from fractures at 50 ft., 65-74 ft. Difficult to distingish furhter fractures with discharge >60 gpm	49-300	251

D1
GEOLOGIC WELL-LOG

Depth Interval (Feet)	Description
0 - 6.0	Reworked soils - overburden: silt, little fine sand and clay, brown at top, dark brown with depth, damp, greasy texture, rich in organics. Note: Thin peat layer directly overlying bedrock surface.
7.0 - 29.5	Limestone, calcite; light to medium grey; fine grained matrix; highly weathered from 7 - 15 feet; low permeability; rock is fissured more than it is fractured, fissures typically coated with a greenish-grey (10 GY5/2) shale; solution cavities, secondary calcite crystallization observed; vuggy; fossiliferous; sucrosic in places; Fe + Mn staining common in limestone from 7 to 20 feet. Note: Some evidence of water production between 28 and 30 feet.
29.5 - 32.5	Shale, very fine grained; Possibly saturated at top (difficult to discern); light olive grey (5Y 6/1) different from shaley deposits along fissures in limestone--probably dissimilar origins; fissile; greasy texture.

DS
GEOLOGIC WELL-LOG

Depth Interval (Feet)	Description
0 - 6.75	Unconsolidated sediments and reworked soils
6.75 - 29.0	Limestone, calcite; light to medium grey; fine grained matrix; highly weathered from 7 - 15 feet; low permeability; rock is fissured more than it is fractured, fissures typically coated with a greenish-grey (10 GY5/2) shale; solution cavities, secondary calcite crystallization observed; vuggy; fossiliferous; sucrosic in places; Fe + Mn staining common in limestone from 7 to 20 feet. Note: Some evidence of water production between 28 and 30 feet.
29.0 - 29.2	Shale, very fine grained; Possibly saturated at top (difficult to discern); light olive grey (5Y 6/1) different from shaley deposits along fissures in limestone--probably dissimilar origins; fissile; greasy texture.

DI
GEOLOGIC WELL-LOG CONTINUED

Depth Interval (Feet)	Description
32.5 - 106.0	Borderline between calcitic dolomite and dolomitic limestone -- definitely lower $CaCo_3$ content than limestone unit above shale; calcite; very pale orange (10 YR 8/2) to a yellowish grey (5Y 7/2); low matrix permeability, high secondary permeability; fissured, shaley material interspersed along fissures; calcite recrystallization, trace pyrrhite crystals observed; vuggy (solution cavities); sucrosic; fossiliferous. Bedrock texture, color, and grain size more homogenous in this interval than other intervals. Crystalline encrustations common in this zone along fractue planes, probably the result of precipitation from solution/ground water. Note: Shaley material along fissures and fractures has appearance and texture of a weathered calcareous mud. Fractured at 43 ft.; 45 - 46 ft.; 48 - 50 ft.; Initial water production 68 - 70 feet; 74-76 ft.; 78-79; Very fractured 84 - 87; noticeable increase in water production
106 - 150	Similar to previous interval: Calcitic dolomite or dolomitic limestone, calcite; fine grained matrix; predominantly yellowish grey (5Y 7/2) with very pale orange streaks (10 yr 8/2) and dark horizontal banding (paleo-organic rich strata); Sucrosic; vuggy; fossiliferouus; calcite recrystallization of fossils; trace pyrrhite; soft; brittle. Note: Highly fossiferous from 130 - 140 ft. Highly fractured from 95 - 125 ft., primary water producing zone

END OF BOREHOLE

DD
GEOLOGIC WELL-LOG

Depth Interval (Feet)	Description
0 - 2	Top soil and gravel fill - saprolitic appearance
2 - 2.5	Weathered calcitic dolomite, grey, dry
2.5 - 3.0	Silt, little clay and fine sand, assorted calcitic dolomite gravel, light brown, dry
3.0 - 4.0	Silt and fine sand, dark brown, moist, lighter brown with depth
4.0 - 6.5	Fine sand and silt, dark grey to black, damp rich in organics
6.5 - 30.0	Thin horizon (1") of weathered shale or peat above bedrock. Bedrock - Calcitic dolomite, grey, dry, solid, competent. Softer material at 14' - peat or shale horizon, shale interspersed in cuttings, no distinct horizons observed between 14 and 30 feet.
32 - 33	Water production increase from .10 gpm - .25 gpm (gallons per minute)
30 -34	Brown shale horizon, very fine grained

DD
GEOLOGIC WELL-LOG CONTINUED

Depth Interval (Feet)	Description
34 - 80	Calcitic dolomite - pale brown, saturated, solid, occasional shale cuttings (possibly kankaki formation) Fracture zones 64 - 67; 79 - 80. Note: Water production up to 2-3 GPM
80 - 93	Calcitic Dolomite; med.-grey; saturated; solid, competent; trace shale cuttings. Fractured zones from 87-89; 90-91
93 - 132	Back into pale brown calcitic dolomite saturated, hard, sucrosic, granular texture observed on some of the cuttings. Note: H_2S odor noticed at 100' gets stronger with depth Highly fractured from 100 - 120 feet, major water producing zone (20 to 30 GPM by 130 feet)
132 - 134	Pale green shale, greasy texture
134 --181	Pale brown calcitic dolomite with shale cuttings interspersed. Fracture zones 144 - 148; 167 - 170.
181 - 300	Light grey to buff calcitic dolomite, solid, hard, porous and permeable with manganese staining. Strong H_2S odor still present. After 220 ft., H_2S odor less noticeable and pervasive. Note: More resistant rock and not fractured much. Note: Detailed description of bedrock formation between 6 and 150 feet provided in geologic log for well DI.

GERAGHTY & MILLER, INC.
Ground-Water Consultants

SAMPLE/CORE LOG

Boring/Well ES Project/No. OH0414IA02 Page 1 of 1

Site Location Alcoa, Davenport, Iowa Drilling Started 1/13/89 Drilling Completed 1/13/89

Total Depth Drilled 24 feet Hole Diameter $6\frac{1}{4}$ inches Type of Sample/Coring Device Grab

Length and Diameter of Coring Device ______ Sampling Interval Continuous feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used Air Drilling Method Air Rotary

Drilling Contractor Albrecht Driller Jeff Hall Helper Brian Colson

Prepared By David L. O'Brien Hammer Weight -- Hammer Drop -- inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description
0	7	--	--	Fill: silt and fine sand, orange brown grading to tan,
				cohesive, damp
7	14			Limestone, tan, fine grain, dry
				- 10' seam yellow brown silt, dry, unconsolidated, 2"
				- 14 seam shale brown to tan, saturated
14	24			Limestone, grey and tan intermixing with black banding
				- seams of shale brown to tan interbedded

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Ground-Water Consultants

SAMPLE/CORE LOG

Boring/Well EI Project/No. OHO 414IA02 Page 1 of 2

Site Location Alcoa, Davenport, Iowa Drilling Started 1/16/89 Drilling Completed 1/18/89

Total Depth Drilled 150 feet Hole Diameter $6\frac{1}{4}$ inches Type of Sample/Coring Device Grab

Length and Diameter of Coring Device ______ Sampling Interval ______ feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used Air Drilling Method Air Rotary

Drilling Contractor Albrecht Driller Jeff Hall Helper Brian Colson

Prepared By David L. O'Brien Hammer Weight ______ Hammer Drop ______ inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description
0	7			Fill: silt and fine sand, black grading to a brown,
				cohesive damp
				- 5.5 limestone boulder or shelve, tan
7	17			Limestone, tan, fine grain
				- 14-17 seams of grey shale moderately hard
17	28			Limestone, tan, with black banding with calcite
				crystalization
				- 23-25 fractured with green shale and lt. brown silt
28	51			Limestone, tan, fine grain, less weathered than above
	-			- 37', water production 3-5 gpm
				41-42' fracture water production 10 gpm
51	52			shale, green, soft
52	80			Limestone, tan, with seams of green shale, fractured
				-fracture with increased water production 12 gpm
				-67' green shale seam
				-68' faint H_2S odor
80	150			Limestone, tan, fine grain with seams of green shale,
				fractured
				- 88-90 seams green, shale, with the H_2S odor becoming
				stronger

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Ground-Water Consultants

SAMPLE/CORE LOG (Cont.d)

Boring/Well EI

Page 2 of 2

Prepared By David L. O'Brien

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
80	150			- 92-117 several fractures throughout
				- 127-137 seams green shale fractured

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Ground-Water Consultants

SAMPLE/CORE LOG

Boring/Well ED Project/No. OH0414IA02

Site Location Alcoa, Davenport, Iowa Drilling Started 1/11/89 Drilling Completed 1/17/89

Total Depth Drilled 297 feet Hole Diameter 6¼ inches Type of Sample/Coring Device Grab

Length and Diameter of Coring Device ______ Sampling Interval Continuous feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used Air Drilling Method Air Rotary

Drilling Contractor Albrecht Driller Jeff Hall Helper Brian Colson

Prepared By David L. O'Brien Hammer Weight -- Hammer Drop -- inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	7	--	--	Fill; silt and fine sand, dark brown to orange brown,
				damp, no odor
7	19			Limestone, tan, fine grain
				- at 16 feet 3 inch shale seam
				- cuttings appear damp to moist
19	22			Shale, green, soft, damp to moist
22	25			Limestone, tan, fine grain
25	32			Shale, green to grey, saturated greasy texture
32	37			Limestone, tan with green shale seams
				- 32-35 seams of a siltstone grey, hard, saturated
37	44			Limestone, tan, fine grain, with green shale seams
44	53			Limestone grey and tan, fine grain
				- 52-53 seam of green shale
53	59			Limestone tan, fine grain with seams green and dark
				green shale, traces of pyrite
59	77			Limestone, tan, fine grain with decreasing seams of
				green shale and fractures
				- 75-80' water production 1-2 gpm
77	78			Shale, green, soft, greasy
78	90			Limestone, tan to grey, fine grain, more dolomitic

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SAMPLE/CORE LOG (Cont.d)

Boring/Well ED

Prepared By David L. O'Brien

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
				- 83' fracture increased water production to 5-6 gpm
				- 87' water production increased 10 gpm with H_2S odor
90	100			Limestone, tan to grey as above with several seams of
				green shale
				- 100' fracture water production increased to
				15-20 gpm
100	165			Limestone, tan fine grain fractured, with seams of green
				and grey brown shale, trace pyrite
				- 110-125' water production increased to 20 gpm
165	174			Limestone, tan, fine grain more heavily fractured
				- with some increased water production
174	175			Shela/chalk, white soft
175-200				Limestone, tan, fine grained
				- 193' water production gradually increasing with
				depth to 25-30 gpm
200	223			Limestone, tan, fine grain fractured
				- gradual water production to 5-6 gpm
223	297			Limestone, white to tan fine grain, hard
				- 233-236' fractured, increased water production to
				6-8 gpm
				- 238 fracture 1 foot
				- 241 fracture 1 foot
				- 250-251 fractured

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Ground-Water Consultants

SAMPLE/CORE LOG

Boring/Well FS Project/No. OH0414IA02 Page 1 of 1

Site Location Alcoa, Davenport, Iowa Drilling Started 1/24/89 Drilling Completed 1/25/89

Total Depth Drilled 28 feet Hole Diameter 8 3/4,6 inches Type of Sample/Coring Device Grab

Length and Diameter of Coring Device ______ Sampling Interval Continuous feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used Air Drilling Method Air Rotary

Drilling Contractor Albrecht Driller Jeff Hall Helper Brian Colson

Prepared By David L. O'Brien Hammer Weight -- Hammer Drop -- inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	5			Fill: silt/clay fine sand, black grading to orange
				brown, damp cohesive
5	10			Limestone, tan, fine grain
10	12			Limestone, grey, fine grain, fractured
12	18			Limestone, tan, fine grain with grey limestone intermixing
18	20			Limestone, tan, fine grain
				- 18' fracture water produced at 1 gpm
20	28			Limestone tan, fine grain with black speckling
				- 20' iron staining tan limestone
				- 24-25' grey limestone interbedded
				- 27' fracture with water production increasing to
				3-5 gpm, iron staining

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Ground-Water Consultants

SAMPLE/CORE LOG

Boring/Well FI Project/No. OH0414IA02 Page 1 of 1

Site Location Alcoa, davenport, Iowa Drilling Started 1/24/89 Drilling Completed 1/26/89

Total Depth Drilled 150 feet Hole Diameter 8 3/4, 6 1/4 inches Type of Sample/Coring Device Grab

Length and Diameter of Coring Device ______ Sampling Interval ______ feet

Land-Surface Elev. ______ feet ☐ Surveyed ☐ Estimated Datum ______

Drilling Fluid Used Air Drilling Method Air Rotary

Drilling Contractor Albrecht Driller Jeff Hall Helper Brian Colson

Prepared By David L. O'Brien Hammer Weight -- Hammer Drop -- inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	4			Fill; silt/clay and v. fine sand, black grading to
				orange brown cohesive, damp
4	21			Limestone, tan, fine grain
				- 12' grey limestone interbedded
				- 21' green shale seam 0.5'
21	33			Limestone, tan, fine grain
				- 26-27' fractured weathered limestone water
				production 3 gpm
				- 27-33' black and grey limestone mixing with pyrite
				crystallization, water production increased to 5-7 gpm
33	40			Limestone, tan, fine grain with green shale packets.
				- 40' green shale seam
40	85			Limestone, tan, fine grain with samll green shale seams,
				locally vesicular with pyrite crystals
				- 47' increase water production to 7-10 gpm
				- 58-79' green shale seams
85	150			Limestone, tan, fine grain, fractured with interbedded
				grey limestone and seams of green shale
				- 92' seam green shale
				- 112-139' several fractures

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Ground-Water Consultants

SAMPLE/CORE LOG

Boring/Well FD Project/No. OH0414IA02 Page 1 of 2

Site Location Alcoa, Davenport, Iowa Drilling Started 1/19/89 Drilling Completed 1/25/89

Total Depth Drilled ____ feet Hole Diameter 8 3/4, 6 1/4 inches Type of Sample/Coring Device ---

Length and Diameter of Coring Device ____ Sampling Interval Continuous feet

Land-Surface Elev. ____ feet ☐ Surveyed ☐ Estimated Datum ____

Drilling Fluid Used Air Drilling Method Air Rotary

Drilling Contractor Albrecht Driller Jeff Hall Helper Brian Colson

Prepared By David L. O'Brien Hammer Weight -- Hammer Drop -- inches

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 inches	Sample/Core Description
0	4			Fill, silt/clay, very fine sand orange brown, cohesive
				damp
				- Limestone ledge at 0.5-1'
4	10			Limestone, tan, fine grain, with grey limestone
				interbedded
10	11			shale, green, soft greasy, moist to saturated
11	13			Limestone, tan, fine grain
13	28			Limestone, brown, less weathered than above
				- 13-13.5' soft green shale seam
				- 22' water production 1-3 gpm
28	30			Limestone tan with black banding vesicular with pyrite
				crystals
				- 28' water ~~oxida~~tion increase to 5-10 gpm
30	33			Limestone, tan with orange Iron staining, vesicular
				with pyrite crystals
33	39			Limestone, tan with black banding vesicular with pyrite
				crystals
39	65			Limestone, tan, fine grain with samll seams of green
				shale
				- 39' fracture with water production increasing to 15 gpm

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SAMPLE/CORE LOG (Cont.d)

Boring/Well FD

Prepared By David L. O'Brien

Sample/Core Depth (feet below land surface) From	To	Core Recovery (feet)	Time/Hydraulic Pressure or Blows per 6 Inches	Sample/Core Description
				- 52' faint H_2S odor
				- 59' green shale seam
65	91			Limestone, tan, fine grain with semas of green and grey
				shale, vesicular, fractured
				- 65-73' water production increased to 20 gpm
91	92			Shale, green soft
92	98			Limestone tan fine grain with grey limestone interbedded,
				fractured
				- water production increased to 30-40 gpm
98	133			Limestone tan, fine grain with some fractures, locally
				vesicular
				- 128-133' several seams of green shale
133	193			Limestone tan, fine grain, locally vesicular with pyrite
				crystallization, with small seams of green and grey shale
				fractured
193	240			Limestone, tan, fine grain solid
				- borehole cased off to 200'
				- 200-217' water production 1-3 gpm
				- 225' water production increased
				- 230' water production increased to 5-10 gpm (Maximum
				production for air pressure and borehole diameter)
240	297			Limestone, pale tan to white, fine grain, fractured

G&M Form 04 6/86 Southprint 87-1719

SOIL TESTING SERVICES OF IOWA, INC.

CEDAR RAPIDS IOWA CITY DAVENPORT DES MOINES

AUGER BORING DATA

PROJECT: ALCOA BLDG. EXPANSION 823
RIVERDALE, IOWA

DATE: 5-1-79

STSI JOB. NO. 779504

BORING	ELEVATION	DEPTH	SOIL & ROCK CLASSIEICATION	WATER LEVEL
		0.0 - 2.0	(FILL) SANDY SILT TRACE GRAVEL, Brown	
R12W		2.0 - 6.0	SILTY SAND, BROWN	5.0 WS 2.0 AB
		6.0 -12.5	SILTY CLAY, Grey, & Brown	
		12.5 -13.0	GRAVEL	
		13.0 -14.5	CLAYEY SHALE, Grey	
		14.5 -15.5	WEATHERED LIMESTONE	
			Auger Refusal @ 15.5	
		0.0 - 1.0	SANDY SILTY CLAY WITH GRAVEL, Brown	
		1.0 - 2.5	SILTY SAND TRACE CLAY, Brown	6.0 WS 3.0 AB
R11W		2.5 -11.0	CLAYEY SILT TRACE SAND, Dark Brown to Brown	
		11.0 -21.0	CLAYEY SHALE TRACE WEATHERED LIMESTONE, Grey	
		21.0 -23.0	WEATHERED LIMESTON LAYER	
		23 - 34	CLAYEY SHALE, Grey	
		34 -35.5	WEATHERED LIMESTONE,	
			Auger Refusal @ 35.5	
		0.0 - 2.0	(FILL) GRAVEL & SAND, RUBBLE, Brown	
		2.0 -11.0	CLAYEY SILT, Dark Grey to Brown	12' WS 10' AB
		11.0 -12.0	FINE SAND TRACE GRAVEL, Brown	
		12.0'-31.0	SHALE, Grey	
P		31.0 -35.0	WEATHERED LIMESTONE	
			Auger Refusal @ 35	

LOG OF BORING NO. R10W

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
RIVERDALE, IOWA	BLDG. EXPANSION 823

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol
1	SS	1.5	1.2	13	*3600	16.1		
2	SS	1.5	1.5	9	*2000	13.3		
	PA							
3	SS	1.5	0.8	8	*2000	39.1		CL
	PA							
4	SS	1.5	1.5	3	*1000	26.9		CL
	PA							
5	SS	1.5	1.5	3	*1600	27.8		CL
	PA							
6	SS	1.5	0.5	50/6"	*7000	11.3		
	PA							
7	SS	1.5	1.4	60	*9000+	16.6		
	PA							
8	SS	1.5	1.0	50/6"	*9000+	13.7		
	PA							
9	SS	1.5	1.0	50/6"	*9000+	14.9		
	PA							
10	SS	.5	0.5	48	*7600	14.5		
	PA							
11	SS	.4	0.4	50/4"	*9000+	13.5		
	PA							
12	SS	.3	.3	50/3"		13.8		
	PA							
13	SS	.2	.2	60/2"		14.0		

Depth: 5, 10, 15, 20, 25, 30

Elevation

Description

(FILL) SILTY CLAY TRACE SAND AND Gravel, Brown, Stiff (1.5')

SANDY SILT, Brown, Medium (3.2')

CLAYEY SILT, Brown to Light Grey, Medium (12.0')

CLAYEY SHALE, Grey, Very Dense (22.0')

CLAYEY SHALE TRACE WEATHERED LIMESTONE) Grey, Dense (250')

CLAYEY SHALE, Grey, Very Dense (30.0')

Continued on Sheet 2

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	7.0	W.S. OR W.D.	A.B.
W.L.		B.C.R.	A.C.R.
W.L.			

SOIL TESTING SERVICES of IOWA, INC.
Cedar-Rapids — Iowa City
Davenport Des Moines

BORING STARTED 4-27-79	
BORING COMPLETED 4-27-79	
RIG CME 55	FOREMAN D.S.
APPROVED RKL	JOB # 779504

LOG OF BORING NO. R10W (Cont.)

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE RIVERDALE, IOWA	**PROJECT NAME** BLDG. EXPANSION 823

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											Cont. from Sheet 1
									30		(30.0')
	PA										
14	SS	1.3	1.3	50/3"		16.8					CLAYEY SHALE Grey, Very Dense
	PA										
15	SS	.5	.5	50/6"		15.0			35		
	PA										
16	SS	1.0	1.0	60/6"	*9000+	15.6					
	PA										(39.0')
17	SS	.5	.5	70SSB		18.7			40		WEATHERED LIMESTONE
	PA										(40.5')
											Auger Refusal @ 40.5 Bottom of Boring

*CALIBRATED PENETROMETER

SSB = SPLIT SPOON BOUNCING

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			SOIL TESTING SERVICES of IOWA, INC.	BORING STARTED 4-27-79	
W.L.	W.S. OR W.D.	A.B.	Cedar Rapids — Iowa City	BORING COMPLETED 4-27-79	
W.L.	B.C.R.	A.C.R.	Davenport, Des Moines	RIG CME 55	FOREMAN DS
W.L.				APPROVED RKL	JOB # 779504

LOG OF BORING NO. R-1

OWNER
ALUMINUM COMPANY OF AMERICA

ARCHITECT-ENGINEER

SITE
RIVERDALE, IOWA

PROJECT NAME
BLDG. EXPANSION 823

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	PA										
1	SS	1.5	.5	10	*2800 / *3200	23.7		CL			SANDY SILTY CLAY, Dark Grey, Stiff
	PA								5		
2	SS	1.5	1.2	7	* 600 / *1000	26.0		CL			(6.5')
	PA										
3	SS	1.5	1.5	5		23.0		SP			FINE TO MEDIUM SAND TRACE SILT, Grey, Loose
	PA								10		(10.0')
4	SS	1.5	1.5	5	* 800	33.1		ML			SILT TRACE CLAY AND SAND, Grey, Soft
	PA										(12.0')
5	SS	.3	.3	50/3"		10.6					(13.0') FINE TO MEDIUM SAND, Grey
	PA										SHALE, Grey, Very Dense
6	SS	.2	.2	50/2"		10.2			15		(15.5')

*CALIBRATED PENETROMETER

Auger Refusal @ 15.5'
Bottom of Boring

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	5.5 W.S. OR W.D.	4.0 A.B.	
W.L.	B.C.R.	A.C.R.	
W.L.			

SOIL TESTING SERVICES
of IOWA, INC.
Cedar Rapids — Iowa City
Davenport Des Moines

BORING STARTED 4-20-79	
BORING COMPLETED 4-20-79	
RIG CME 55	FOREMAN DAS
APPROVED	JOB # 779504

LOG OF BORING NO. R5W

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	PROJECT NAME
RIVERDALE, IOWA	BLDG. EXPANSION 823

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	PA										(0.5') Gravel
1	SS	1.5	.5	9	*2500	34.1					(FILL) CLAYEY SILT TRACE GRAVEL, Brown (3.5')
	PA										
2	SS	1.5	1.5	7	*2000	24.7		ML	5		SILT TRACE CLAY, SAND AND ORGANICS, Gray Brown, Soft to Medium
	PA										
3	SS	1.5	1.5	7	* 800	27.9		ML			
	PA										(9.5')
4	SS	1.5	1.5	41	*3000	25.3			10		(10.5') FINE TO COARSE SAND, Gray
	PA										
5	SS	1.5	1.5	50/4"	*9000+	14.3					
	PA										
6	SS	1.5	.3	50/4"	*9000+	13.1			15		CLAYEY SHALE, Gray, Very Dense to Extremely Dense
	PA										
7	SS	1.5	.8	100/6"	*9000+	13.8					
	PA										
8	SS	.5	.5	75/3"	*9000+	15.2			20		
	PA	-									
~~9~~	~~SS~~	~~.5~~	~~.3~~	~~75/3"~~	~~*2500~~	~~15.3~~					
	PA										
10	SS	1.0	.3	75/3"	*9000+	10.3					
	PA								25		(27.5')
11	SS	.5	.5	100/6"	*9000+	16.3					Auger Refusal @ 27.5' Bottom of Boring
									30		

*CALIBRATED PENETROMETER

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	W.S. OR W.D.	A.B.	
W.L.	B.C.R.	A.C.R.	
W.L.			

SOIL TESTING SERVICES of IOWA, INC.
Cedar Rapids — Iowa City
Davenport — Des Moines

BORING STARTED	
BORING COMPLETED	
RIG	FOREMAN
APPROVED	JOB #

LOG OF BORING NO. P5W

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	PROJECT NAME
RIVERDALE, IOWA	BLDG. EXPANSION 822

Sample No.	Type Sample.	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
	PA										SILT-LITTLE CLAY TRACE SAND AND ORGANICS, Dark Brown, Loose
1	SS	1.5	1.0	11		47.3		ML			(3.5')
	PA								5		SILT SOME CLAY TRACE SAND, Dark Grey, Loose Medium
2	SS	1.5	.5	6		31.6		CL			
	PA										
3	SS	1.5	1.0	6	*1200	25.8		CL			
	PA										(9.5')
4	SS	.3	.1	50/2"		7.4			10		SANDY SHALE, Grey, Very Dense
	PA										
5	SS	1.5	1.5	48	*9000+	13.2					
	PA								15		
6	SS	1.5	1.5		*9000+	14.6					(17.0')
	PA										
7	SS	.8	.8	60/3"	*9000+	11.3					CLAYEY SHALE, Grey Very Dense
	PA										
8	SS	.9	.8	60/4"	*9000+	17.6			20		
	PA	-									
9	SS	.4	.3	90/4"		10.9					(24.1')
									25		Auger Refusal @ 24.1'
											Bottom of Boring
									30		

*CALIBRATED PENETROMETER

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L.	19.0 W.S. OR W.D.	17.0	A.B.
W.L.	B.C.R.		A.C.R.
W.L.			

SOIL TESTING SERVICES of IOWA, INC.
Cedar Rapids — Iowa City
Davenport Des Moines

BORING STARTED	4-20-79
BORING COMPLETED	4-20-79
RIG CME 55	FOREMAN DAS
APPROVED	JOB #779504

LOG OF BORING NO. 05W

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMAPNY OF AMERICA	
SITE	**PROJECT NAME**
RIVERDALE, IOWA	BLDG. EXPANSION 821

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description
											(0.2') ASPHALT
	PA										
1	SS	1.5	1.3	10	*1200	16.0		ML			SILT SOME SAND AND CLAY Brown to Dark Brown, Loose
	PA								5		
2	SS	1.5	0.8	8	*2200	32.9		ML			(6.0')
	PA										
3	SS	1.5	1.0	4	*1000	38.4		CL			CLAYEY SILT, TRACE SAND AND GRAVEL, Grey Brown to Grey, Medium to Stiff
	PA										
4	SS	1.5	1.0	6	*3000	32.9		CL	10		
	PA										(12.0')
5	SS	1.5	1.3	30	*9000+	26.2					
	PA										
6	SS	1.5	1.2	70	*9000+	15.7			15		
	PA										
7	SS	1.5	1.0	88	*9000+	15.5					CLAYEY SHALE, Grey, Very Dense to Extremely Dense
	PA										
8	SS	.5	.5	100/6"	*9000+	13.5			20		
	PA										
9	SS	1.0	.5	69/6"	*9000+	15.0					
	PA										
10	SS	1.5	.2	80/3"		20.0			25		
	PA										
11	SS	.3	.3	100/4"	*4000	15.0					
	PA										
12	SS	.5	.4	100/6"	*9000+	15.8			30		(30.5')
											Auger Refusal @ 30.5' Bottom of Boring

*CALIBRATED PENETROMETER

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				
W.L. 8'	W.S. OR W.D.	0	A.B.	
W.L.	B.C.R.		A.C.R.	
W.L.				

SOIL TESTING SERVICES
of IOWA, INC.
Cedar Rapids — Iowa City
Davenport Des Moines

BORING STARTED 4-30-79	
BORING COMPLETED 4-30-79	
RIG CME 55	FOREMAN JF
APPROVED	JOB #779504

LOG OF BORING NO. 012W

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
RIVERDALE, IOWA	BLDG. EXPANSION 821

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol
	PA							
1	SS	1.5	1.3	8	*2000	17.6		SM
	PA							
2	SS	1.5	1.1	8	*3000	30.4		CL
	PA							
3	SS	1.5	.8	6	*3000	29.1		CL
	PA							
4	SS	1.5	1.3	3	*1000	31.4		CL
	PA							
5	SS	1.5	1.3	4	* 600	32.5		CL
	PA							
6	SS	1.5	1.0	50/2"		14.6		SM
	PA							
7	SS	1.5	0	80/1"				SM
	PA							
8	SS	1.5	.8	80/4"	*9000	15.5		
	PA							
9	SS	1.5		142	*9000	14.0		
	PA							
10	SS	1.5	1.1	80/4"	*9000	14.9		
	PA							
11	SS	.1	0	50/1"	*9000			
	PA							
12	SS	1.1	1.0	50/2"	*9000	163		

*CALIBRATED PENETROMETER

Depth: 5, 10, 15, 20, 25, 30

Description

(0.3') CRUSHED STONE

SILTY FINE SAND,
Dark Brown, Loose
(4.5')

CLAYEY SILT,
Dark Brown to Greenish Brown, Stiff to Soft
(15.3')

FINE TO MEDIUM SAND WITH SILT TRACE GRAVEL AND CLAY,
(19.5')

CLAYEY SHALE,
Grey, Very Dense
(30.5')

CONTINUED ON SHEET 2

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			
W.L. 10	W.S. OR W.D.	7.0	A.B.
W.L.	B.C.R.		A.C.R.
W.L.			

SOIL TESTING SERVICES of IOWA, INC.
Cedar Rapids — Iowa City
Davenport — Des Moines

BORING STARTED	4-30-79
BORING COMPLETED	5-1-79
RIG CME 55	FOREMAN KW
APPROVED	JOB # 779504

LOG OF BORING NO. 012W

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	PROJECT NAME
RIVERDALE, IOWA	BLDG. EXPANSION 821

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.²	Water Content-%	Dry Density-lbs./ft.³	Unified Class. Symbol	Depth	Elevation	Description
											CONT. FROM SHEET 1
									30		
	PA										
13	SS	.9	.9	60/4"	*9000+	19.3					
	PA										CLAYEY SHALE, Grey, Very Dense
14	SS	.7	.8	50/3"	*8500	15.0			35		
	PA										
15	SS	.5	.5	54/6"	*7000	15.0					
	PA										
16	SS	.9	.9	60/4"	*8800	18.4			40		
	PA										
17	SS	.9	.8	60/4"	*8000	14.0					
	PA										(44.0')
											Auger Refusal @ 44.0' Bottom of Boring

*CALIBRATED PENETROMERTER

THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS			SOIL TESTING SERVICES of IOWA, INC. Cedar Rapids — Iowa City Davenport Des Moines	BORING STARTED	
W.L.	W.S. OR W.D.	A.B.		BORING COMPLETED	
W.L.	B.C.R.	A.C.R.		RIG	FOREMAN
W.L.				APPROVED	JOB #

LOG OF BORING NO. KL13W

OWNER	ARCHITECT-ENGINEER
ALUMINUM COMPANY OF AMERICA	
SITE	**PROJECT NAME**
RIVERDALE, IOWA	BLDG. EXPANSION 818

Sample No.	Type Sample	Sampling Distance	Recovery	Blows/ft.	Unconfined Compressive Strength-lbs./ft.^{2}	Water Content-%	Dry Density-lbs./ft.^{3}	Unified Class. Symbol	Depth	Elevation	Description OFFSET 3' SOUTHWEST
	PA										
1	SS	1.5	1.0	12	*3600	38.8		CL			SILTY CLAY, Brown, Medium to Stiff
	PA										
2	SS	1.5	1.5	10	*2800	34.5		CL	5		(7.0')
	PA										
3	SS	2.5	1.5	7	*2000	26.9		CL			CLAYEY SILT, Light Grey, Stiff (10.0')
4	SS	1.5	1.5	50		17.4			10		HIGHLY WEATHERED & BROKEN LIMESTONE AND FINE TO COARSE GRAVEL, Brown, Very Dense
	PA										
5	SS	1.5	1.0	64		7.5					(14.5')
	PA										
6	SS	1.5	0.8	60/5"	*9000	15.6			15		SHALE, Grey, Very Dense (16.3')
											Bottom of Boring

*CALIBRATED PENETROMETER

Depth scale: 5, 10, 15, 20, 25, 30

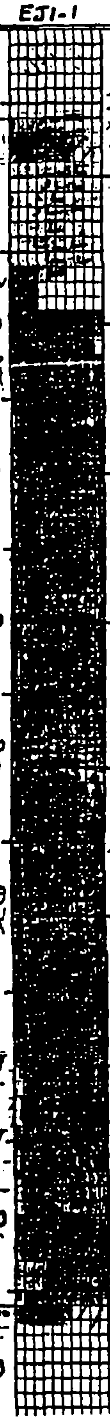
THE STRATIFICATION LINES REPRESENT THE APPROXIMATE BOUNDARY LINES BETWEEN SOIL TYPES: IN-SITU, THE TRANSITION MAY BE GRADUAL.

WATER LEVEL OBSERVATIONS				SOIL TESTING SERVICES of IOWA, INC. Cedar Rapids — Iowa City Davenport Des Moines	BORING STARTED 5-1-79	
W.L.	5.0 W.S. OR W.D.	3.0	A.B.		BORING COMPLETED 5-1-79	
W.L.	B.C.R.		A.C.R.		RIG	FOREMAN KW
W.L.					APPROVED	JOB # 779504

FORM NO. 79—In stock and for sale by Ross-Martin Co., Tulsa. W-7622

STATE IOWA	RIVERDALE (SCOTT)
~~SENERAL~~	ALUMINUM Co. of AMERICA [redacted]
SEC. ~~26~~ 23	SE SE SW
TWP. 78N RGE. 4E	COMMENCED MAY 2 – COMPLETED JUNE 2, 1956
	LAYNE-WESTERN-KEN. SMITH
	CASING RECORD 126' of 12" CASING
	LOGGED JULY 19, 1956 NORTHUP
EL 595	REMARKS [illegible]
TD 440'	

EJI-1



Loess Yellow, leached

Till Yellow oxidized, partly leached, silty

PLEIS
PENN.
WAPSI. KENWOOD
OTIS
SILURIAN
KANK.
FORTUNA
MAQ.

LS. cam. lito.

LS. cam. lito.

Dol. ... [illegible]

Dol. cam. ... [illegible]

Dol. cam. ... f.

50

100

150

200

250

300

350

400

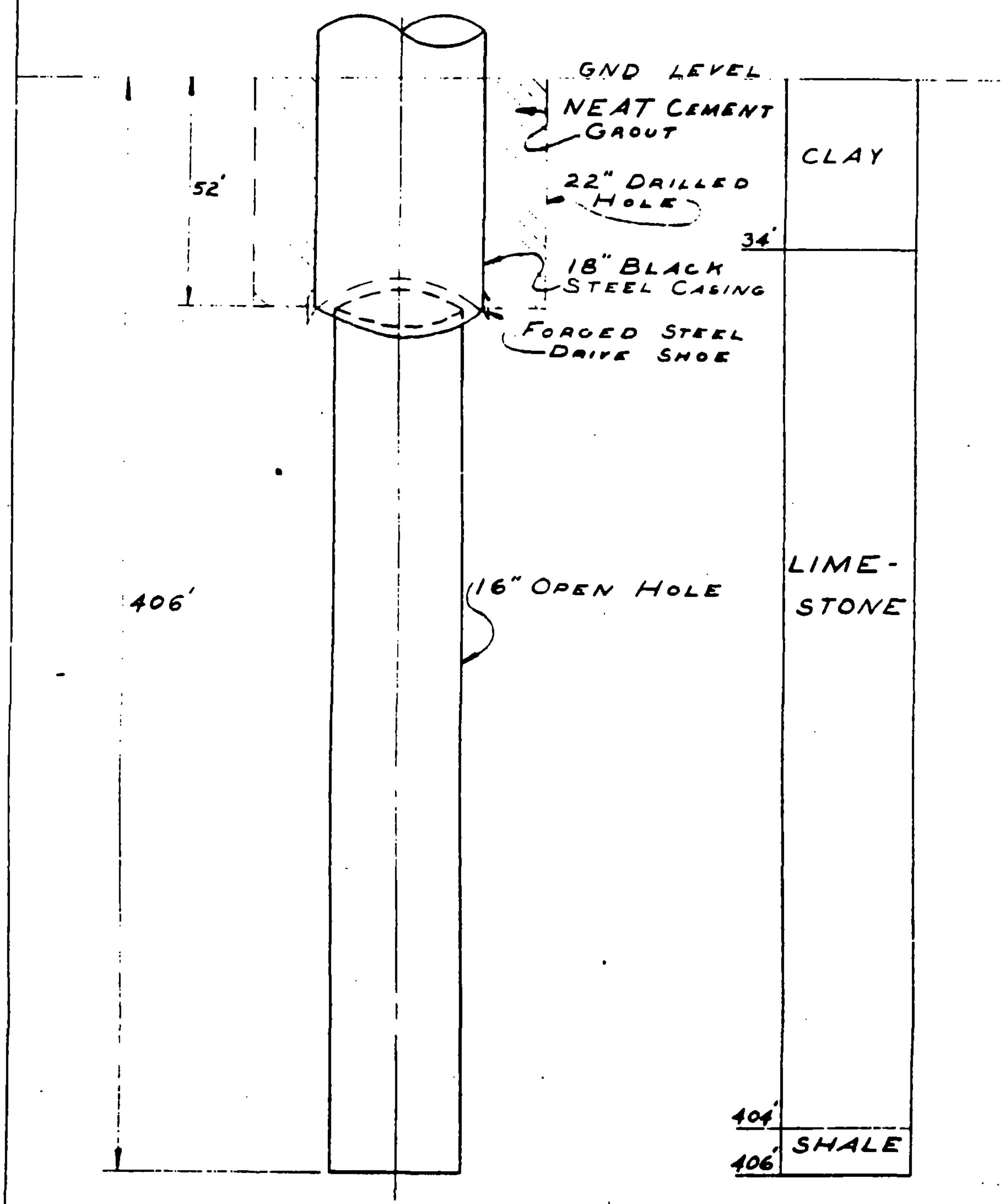
450

DETAILS WELL CONSTRUCTION
WELL #2
for
ALUMINUM COMPANY OF AMERICA

DAVENPORT, IOWA

LAYNE WESTERN CO. AMES, IOWA

CONSTRUCTION LOG

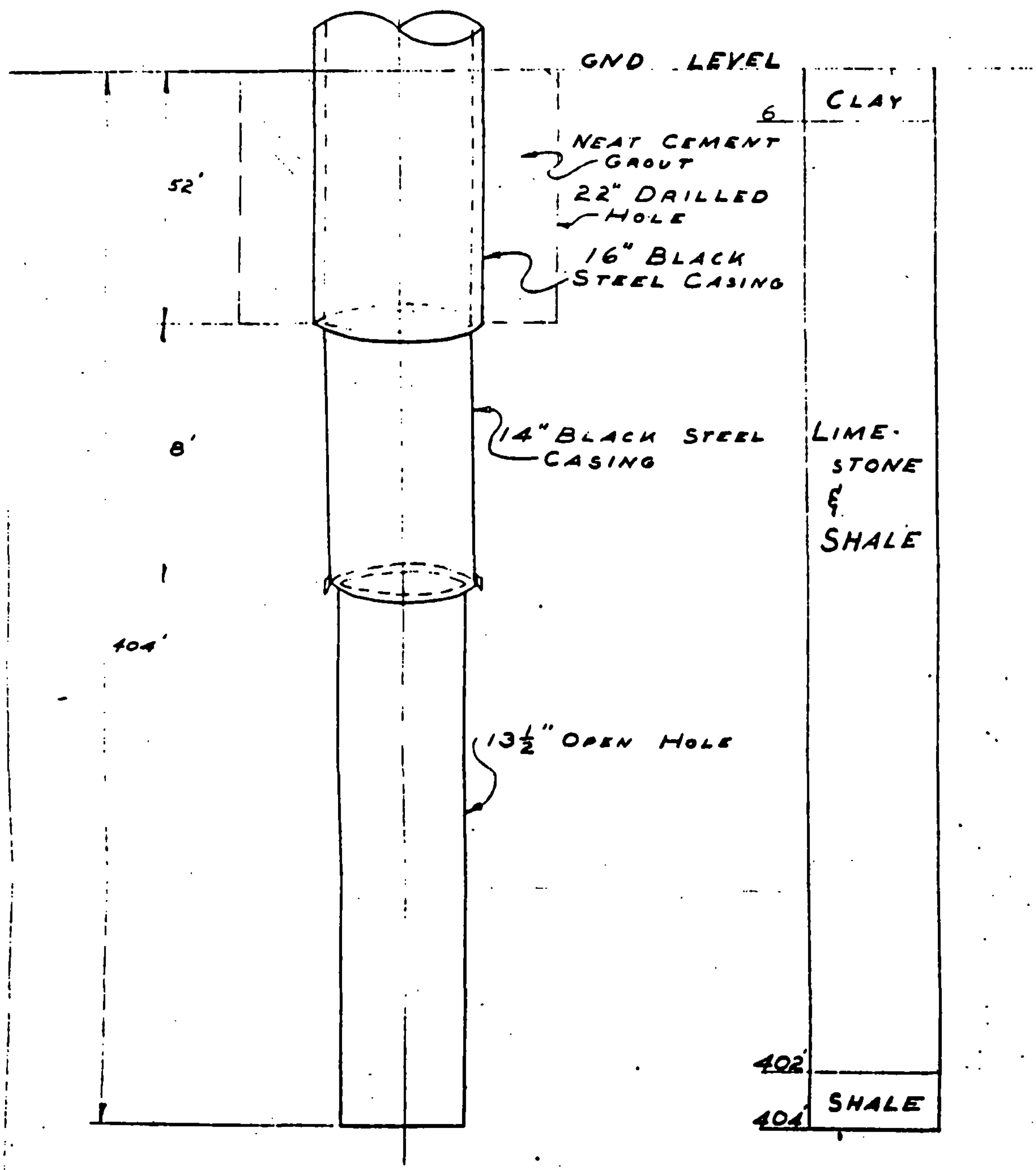


DETAILS WELL CONSTRUCTION
WELL #3
for
ALUMINUM COMPANY OF AMERICA

DAVENPORT, IOWA

LAYNE WESTERN CO. AMES, IOWA

CONSTRUCTION LOG



DETAILS WELL CONSTRUCTION
WELL # 4

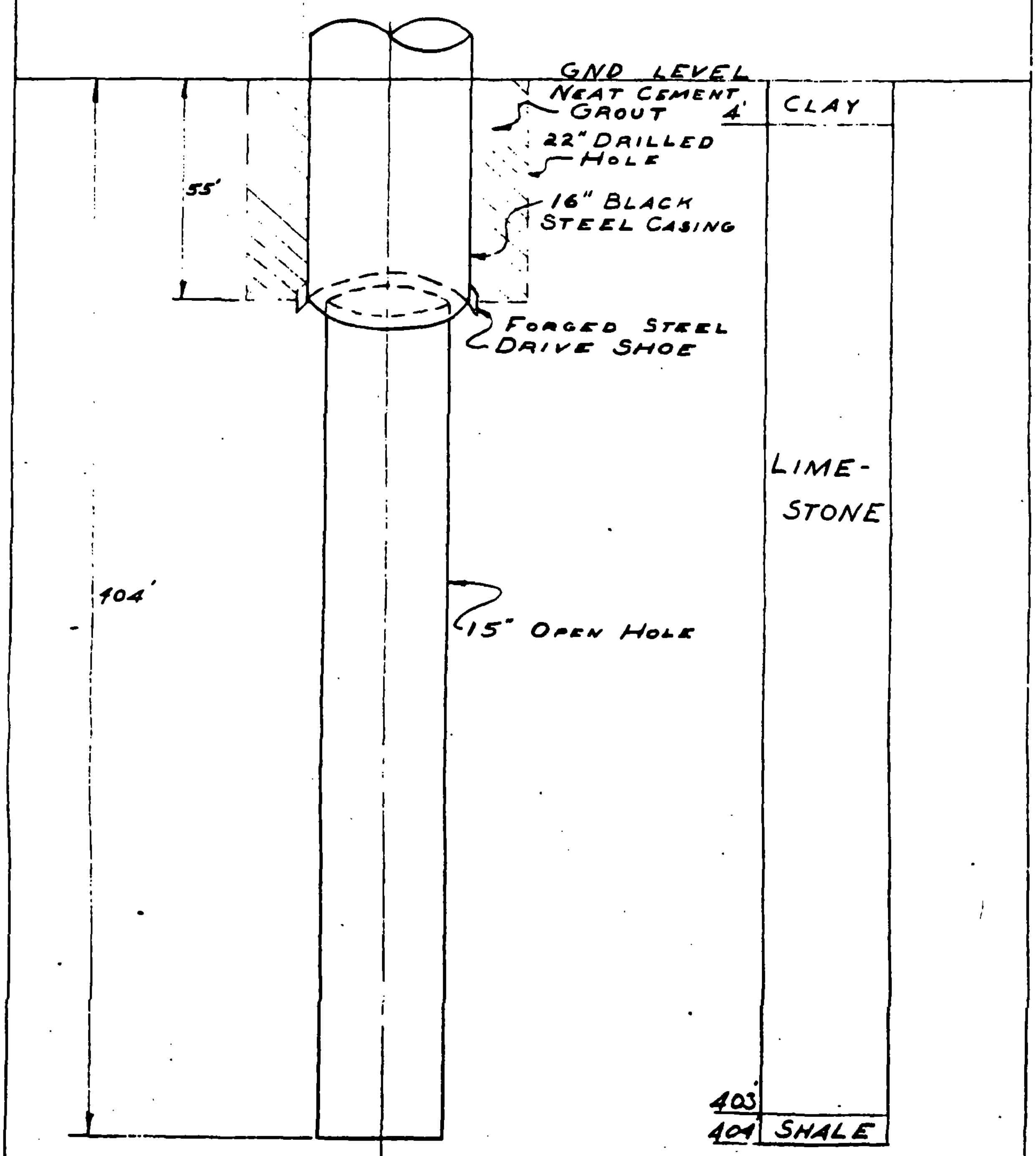
for

ALUMINUM COMPANY OF AMERICA

DAVENPORT, IOWA

LAYNE WESTERN CO. AMES, IOWA

CONSTRUCTION LOG

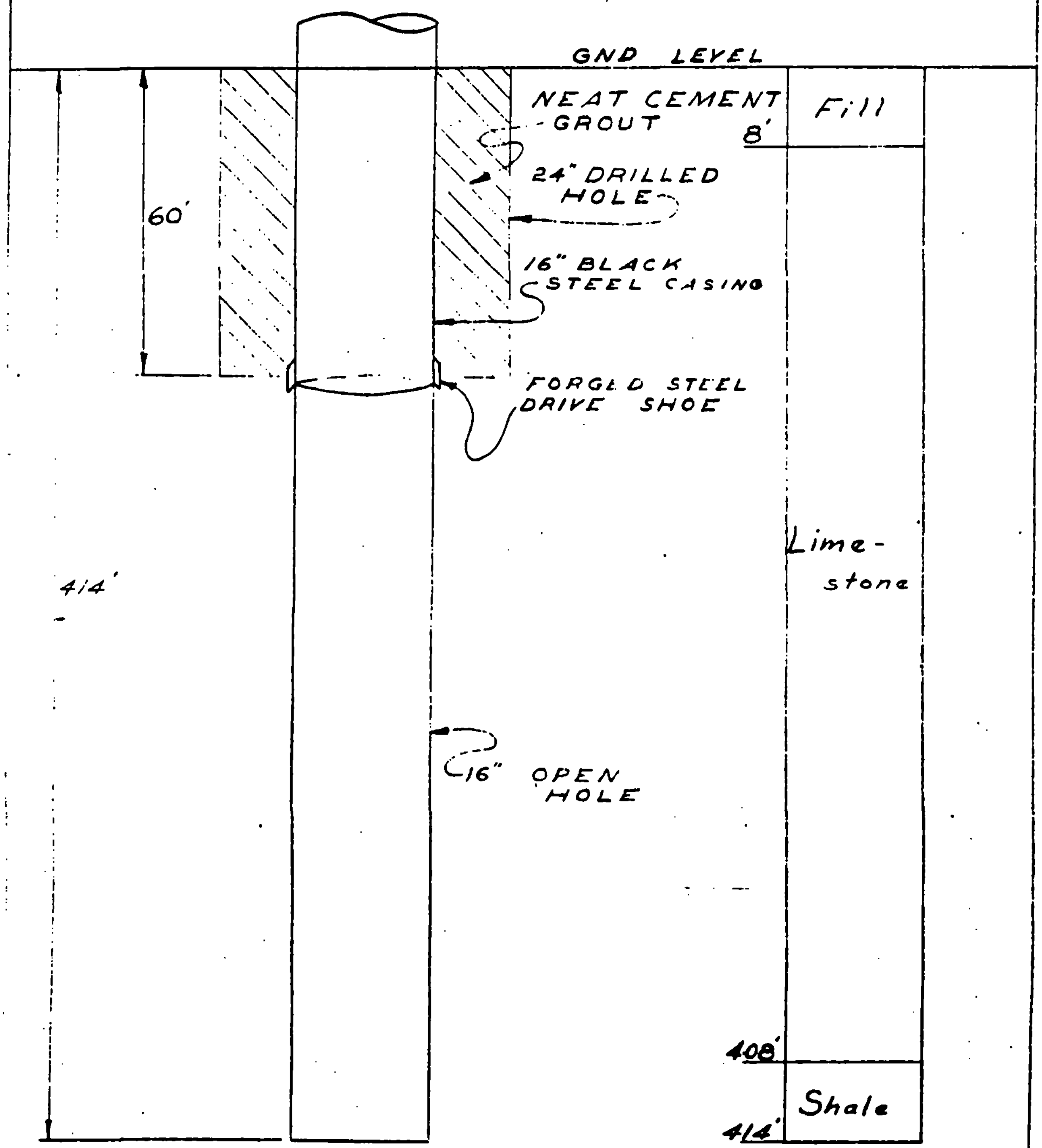


DETAILS WELL CONSTRUCTION
WELL #5
for
ALUMINUM COMPANY OF AMERICA

DAVENPORT, IOWA

LAYNE WESTERN CO. AMES, IOWA

CONSTRUCTION LOG



WELL LOG

Feet		Feet	Description
0	to	5	Clay, brown
5	to	7	Sand, med., brown
13	to	21	Clay, gray
21	to	26	Clay & broken limestone, gray
26	to	44	Limestone & shale, gray
44	to	76	Limestone, gray, hard
76	to	82	Limestone & shale, gray
82	to	90	Limestone, brown, hard
90	to	100	Limestone, brown, with shale streaks
100	to	122	Limestone, brown, hard
122	to	138	Limestone, brown, very hard
138	to	159	Limestone, gray, hard
159	to	172	Limestone, brown, hard
172	to	331	Limestone, gray, hard
331	to	345	Limestone, gray, very hard
345	to	350	Limestone, some chert, gray, very hard
350	to	375	Limestone, gray, very hard
375	to	387	Limestone & chert, gray, some shale, hard
387	to	394	Limestone, brown, hard
394	to	400	Limestone, gray, very hard
400	to	403 TD	Shale, green

FORM NO. 79—In stock and for sale by Ross-Martin Co., Tulsa. W-7622

STATE IOWA	RIVERDALE (SCOTT)
~~SE NE NE~~	ALUMINUM CO-OF AMERICA [redacted]
SEC. ~~26~~ 23	SE SE SW
TWP. 78N RGE. 4E	COMMENCED MAY 2 - COMPLETED JUNE 2, 1956
	LAYNE-WESTERN-KEN-SMITH
	CASING RECORD 126' OF 12" CASING
	LOGGED JULY 19, 1956 BY NORTHUP
EL 595	REMARKS Topo
TD 440'	
EJI-1	

PLEIS
PENN
WAPSI
KENWOOD
OTIS
50
SILURIAN
100
150
200
250
300
350
KANK.
400
FINSWOOD
MAG.
450

LOESS YELLOW, LEACHED
TILL YELLOW OXIDIZED, PARTLY LEACHED, SILTY
SH. [illegible] LUMPY
[illegible]
DOL. [illegible]
DOL. [illegible]
LS. [illegible] LITH.
LS.-CAM. LITH.
LS.-CAM. LITH.
DOL. [illegible]
DOL. [illegible] 90'-95'
DOL. [illegible] CREVICE FILLING
DOL. [illegible] 97 CHERT
DOL.-CAM. TAN. f.
DOL.- CAM. [illegible] f.; [illegible]
DOL. CAM. [illegible] f., SLI. VUGGY
DOL. CAM. f., VUGGY
DOL. CAM. f. [illegible] f.
DOL. CAM. f.
DOL. [illegible] f.
DOL. CAM. f.

571

DOL. CAM. [illegible] TAN. f.
DOL. CAM. f.
DOL. CAM. f.
DOL. [illegible] f.
DOL. CAM. f.
DOL. CAM. f. SLI. VUGGY
DOL. CAM. f.
[illegible]; DOL. CAM. f.
DOL. CAM. f.
[illegible]; DOL. CAM. f.
DOL. CAM. [illegible] f.
DOL. [illegible]
DOL. [illegible]
[illegible]; DOL. TAN. f.
[illegible]; DOL. CAM. TAN. f.
[illegible]; DOL. CAM. f.
DOL. CAM. f. [illegible]
[illegible]

FORM NO. 79—In stock and for sale by Ross-Martin Co., Tulsa. W-11362

STATE Iowa	Riverdale (Scott)
SW SE [illegible] NE	E. R. Thomas
SEC. 23	
TWP. 78N RGE. 4E	COMMENCED Aug. 27-28, 1960 COMPLETED
	L. F. Winslow
	CASING RECORD
	LOGGED Sept. 27, 1960 BY Koch
EL 635	REMARKS SWL 65'
TD 95'	PL 65' @ 10 GPM.
10 [illegible]	
JRC	
SA7-5	

PLEIS
PENN.
50
WAPSI.
OTIS
SIL.
100

Till, yel., oxidized, unleached, v. silty.
Till, [illegible]; oxidized unleached, clayey
Till, Gr., unoxidized, unleached, scattered pebbles
Till a.a., clayey.
Till, Gr., unoxidized, leached; Sh. [illegible]
Sh. [illegible], soft, [illegible] silty.
Sh. [illegible]
Sh. [illegible], sh. a.a.
Ls. Lt. Cam., v.f. sub-lith; [illegible] of gyp. [illegible]
Ls. a.a., coralline
Ls. [illegible] Tan, v.f. to sub-lith & lith., fos.
Ls. Lt. Cam., v.f. & Brn., v.f.
Dol., Tan & Gy Brn., f., [illegible]

635
55
580

[illegible]

FORM NO. 79B - In stock and for sale by Mid-West Prtg. Co., Tulsa [illegible]

STATE [illegible]	[illegible] (Scott)
NE/4 SW [illegible]	[illegible]
SEC. 23	
TWP. [illegible] RGE. [illegible]	COMMENCED [illegible] COMPLETED [illegible]
	CASING RECORD [illegible]
	LOGGED [illegible] BY [illegible]
El. 671'	REMARKS [illegible]
T.D. 357'	SWL [illegible]
	PL [illegible]
	115' [illegible]

671
15
[illegible]

671
170
351

671
357
374

Depth	Log	Formation
		PENNSYLVANIAN
		DEVONIAN Wapsipinicon
		SILURIAN Niagaran
100		
200		
300		Kankakee
400		Edgewood
		ORDOVICIAN Maquoketa
500		

IOWA GEOLOGICAL SURVEY
In Cooperation with
U. S. GEOLOGICAL SURVEY
Iowa City, Iowa

Name: Aluminum Corp. of Am. 5	State: Iowa
Town: Bettendorf County: Scott	Loc.
Contractor: Layne-Western Driller:	Sec.
Drilling Dates: 1956	T. 78 N., R.
Casing Record	
S.W.L. G.P.M. D.D	
Remarks	Elev
	T.D. 415
Logged By: Northup	I.G.S. No. W-7228

Explanation of Colors

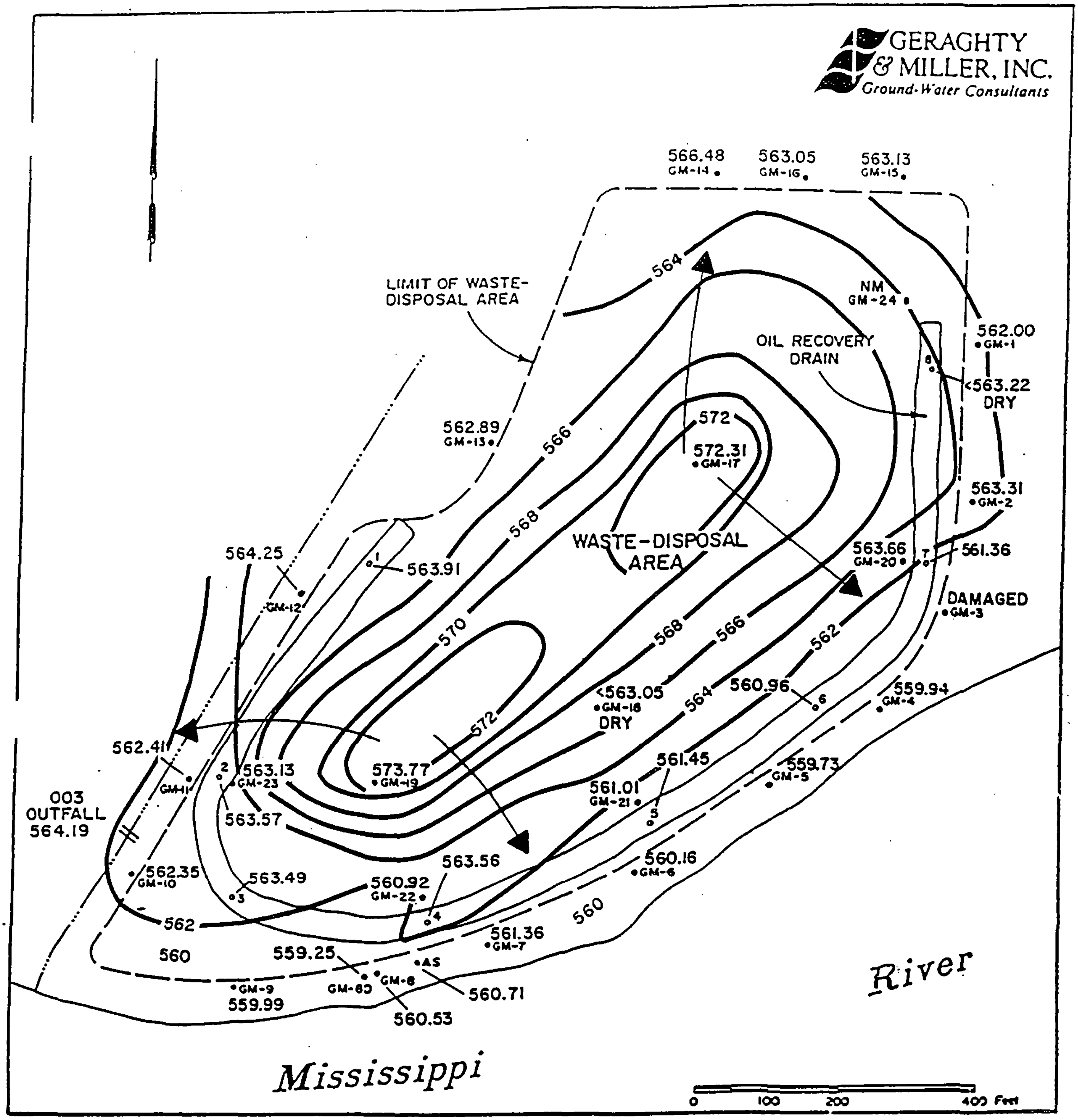
- Drift
- Sand & Gravel
- Shale
- Sandstone
- Limestone
- Dolomite
- Chert
- N S No Samples

A-IV-8

APPENDIX B

Appendix B

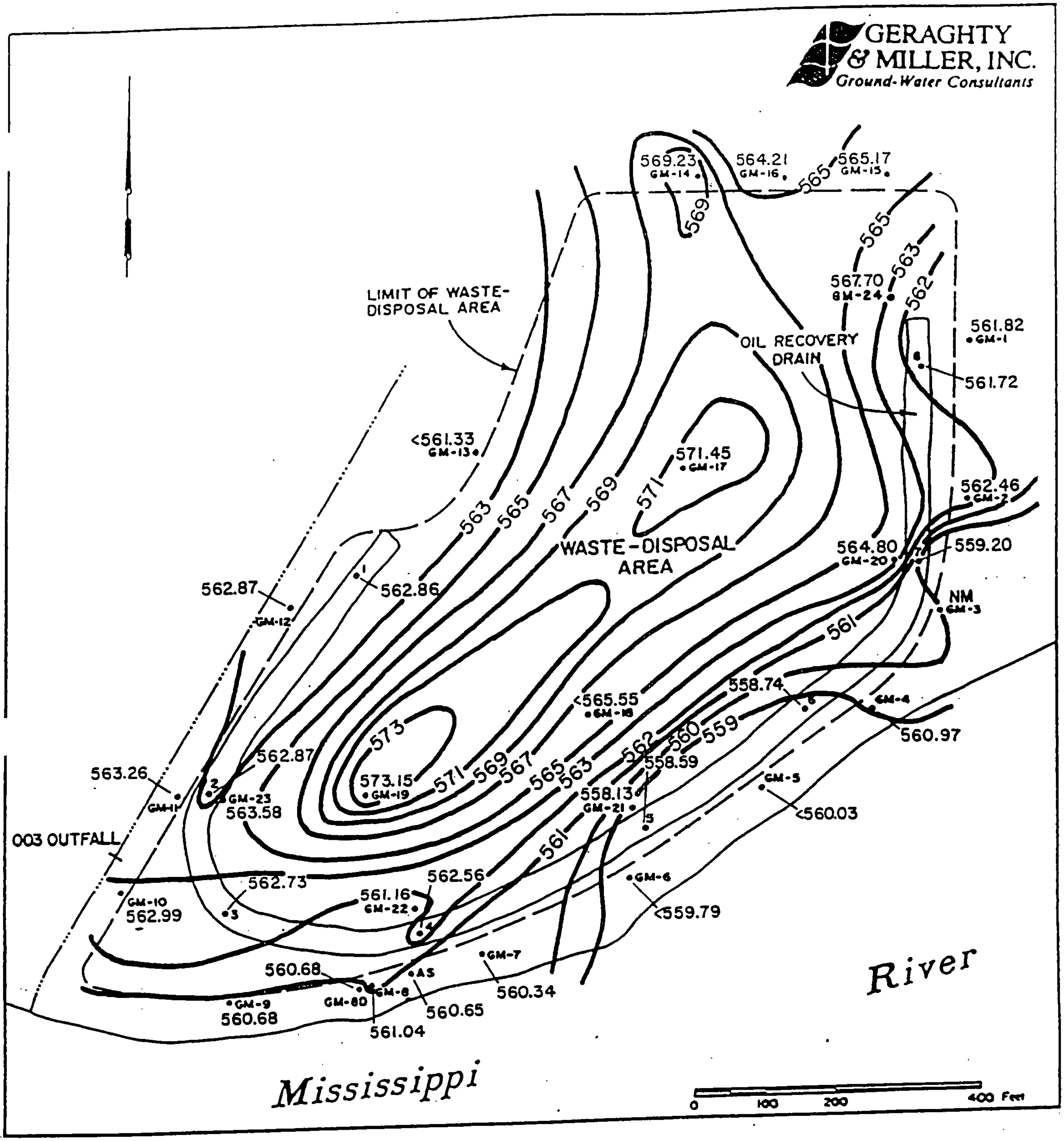
Waste Site Water Level Contour Maps and Hydrographs



EXPLANATION

• 562.00	FLUID LEVEL ELEVATION, IN FEET MSL
NM	NOT MEASURED
——▶	GROUND WATER FLOW DIRECTION
— 560 —	GROUND WATER CONTOUR

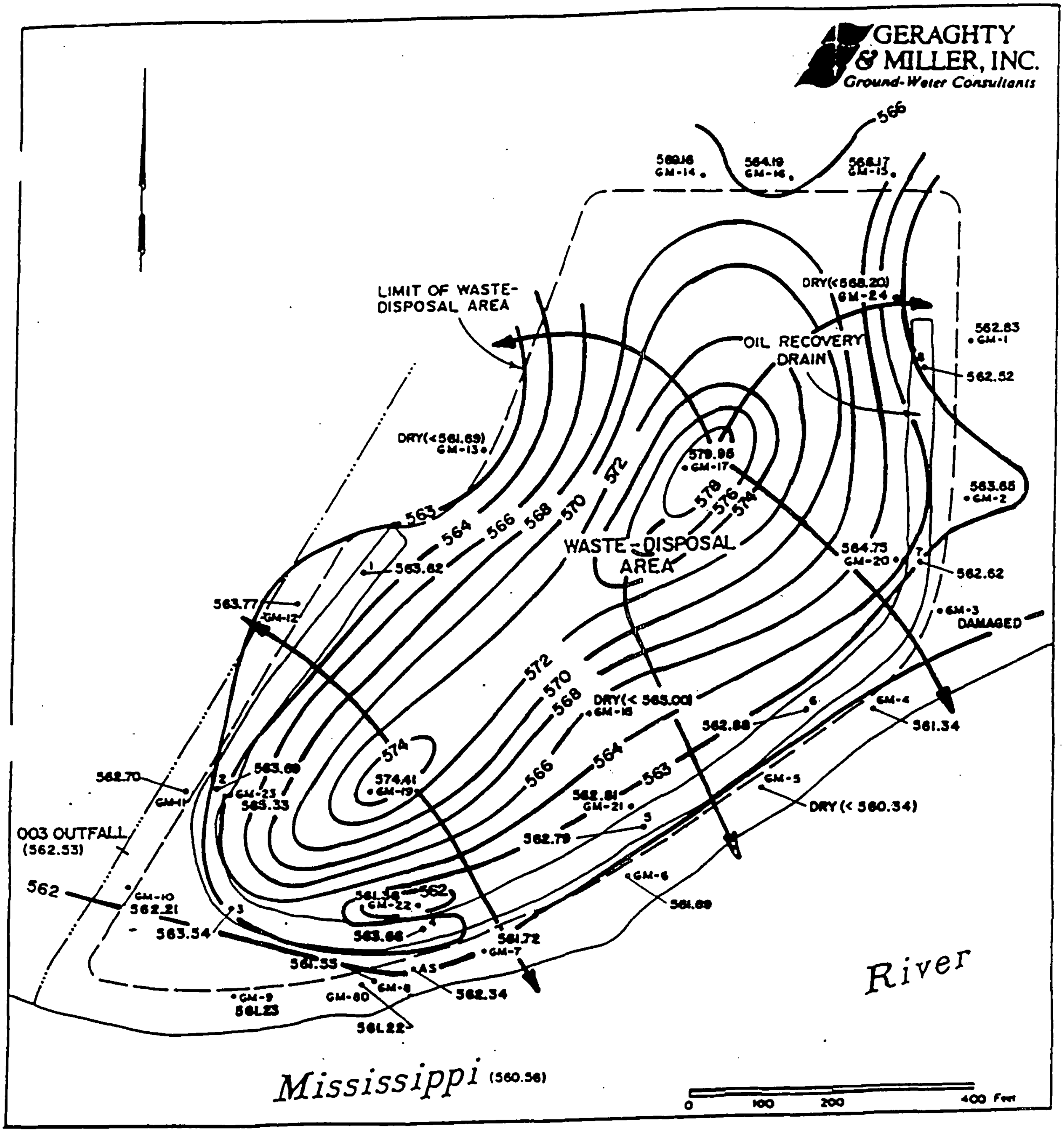
B-1 Ground-Water Contour Map Depicting Flow-Conditions at the Alcoa-Davenport Waste-Disposal Site on August 17, 1988.



EXPLANATION

•GM-16	Monitor well
•8	Collection well
575.96	Fluid-Level Elevation, in feet MSL.
NM	Not Measured
<561.33	Fluid-Level below base of well

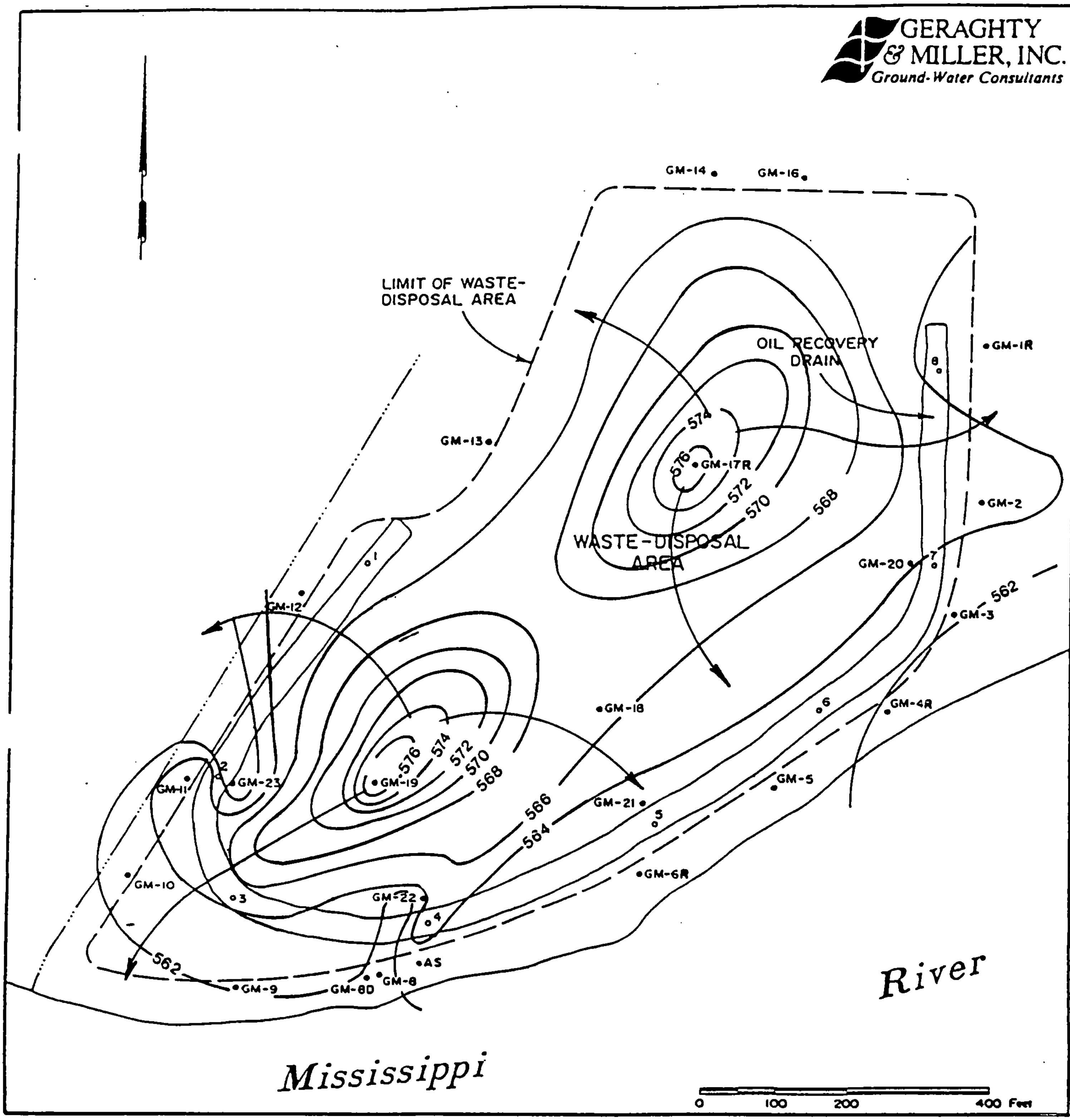
B-2 Ground-Water Contour Map Depicting Flow Conditions at the ALCOA-Davenport Waste-Disposal Site on November 14, 1988.



EXPLANATION

- GM-16 Monitor well
- 8 Collection well
- 561.36 Fluid - Level Elevation, feet MSL
- DRY(<565.00) Water level is below base of well.
- GROUND-WATER FLOW DIRECTION
- 564 GROUND-WATER CONTOUR

B-3 Ground-Water Contour Map Depicting Flow Conditions at the Alcoa-Davenport Waste Disposal Site on February 20, 1989.



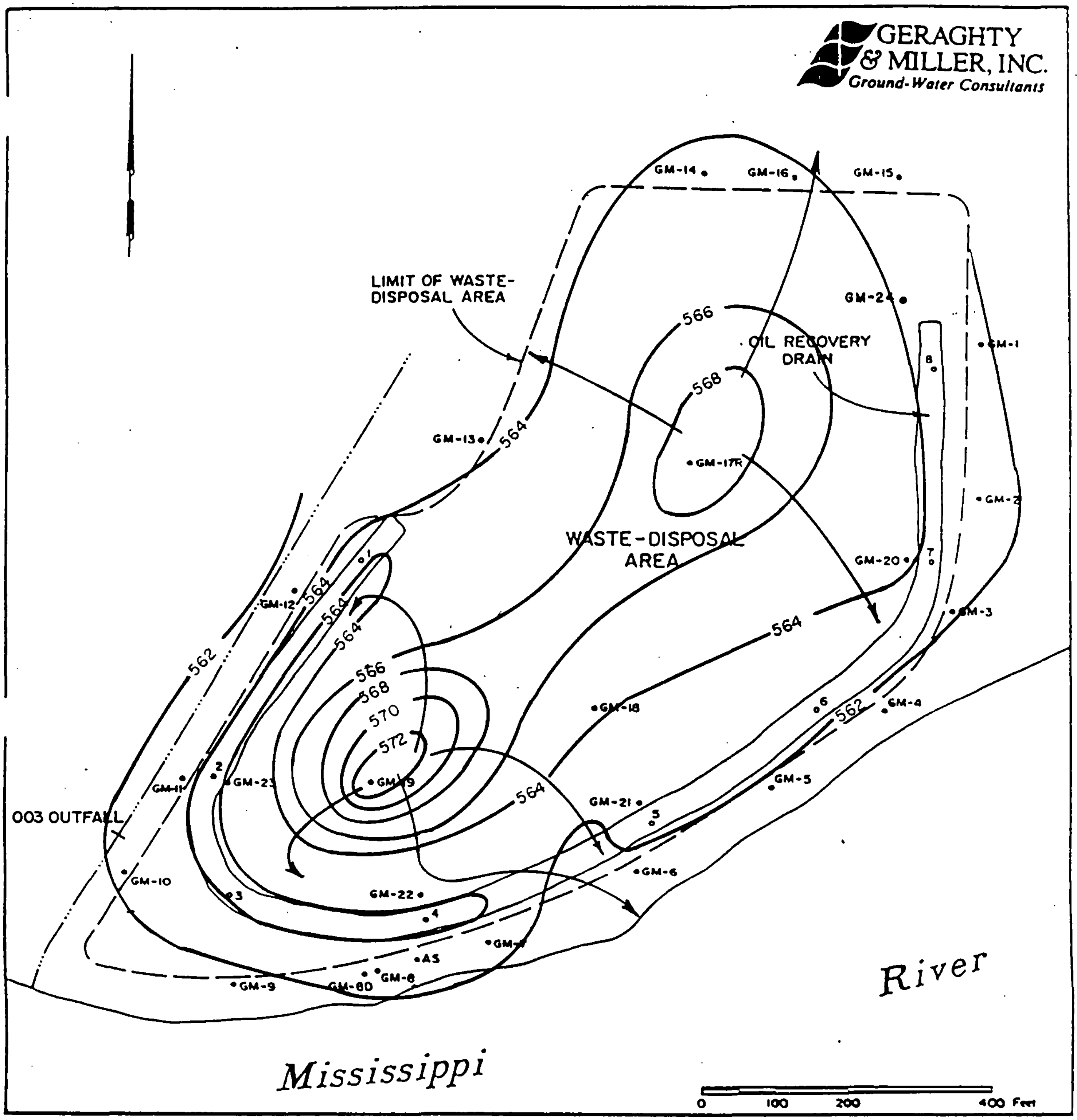
EXPLANATION

GM-16 Monitor Well

o8 Collection Well

GM-17R Replacement Well, Installed April, 1989.

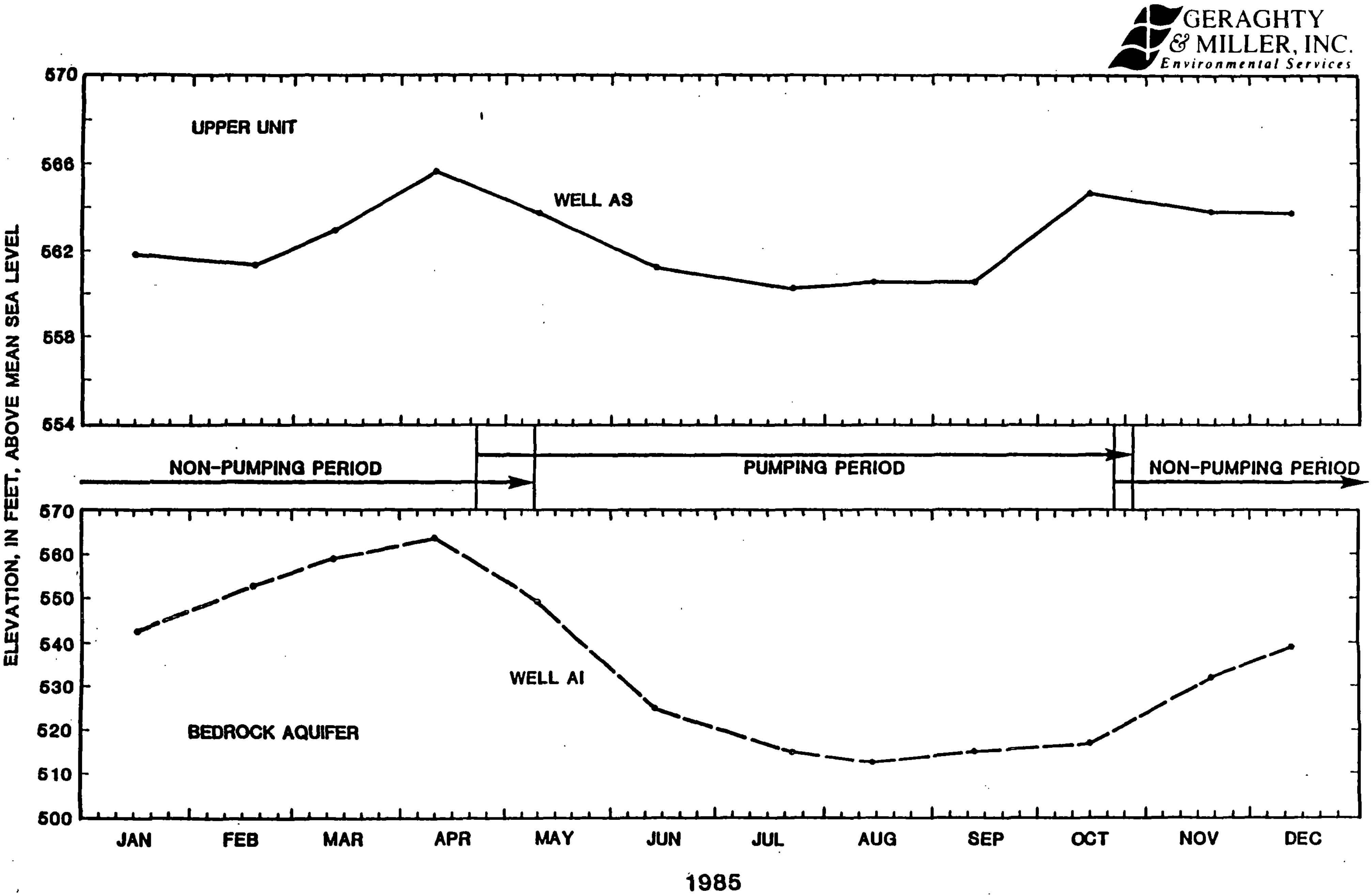
B-4 Ground-Water Contour Map Depicting Flow Conditions at the Alcoa-Davenport Waste-Disposal Site on May 17, 1989.



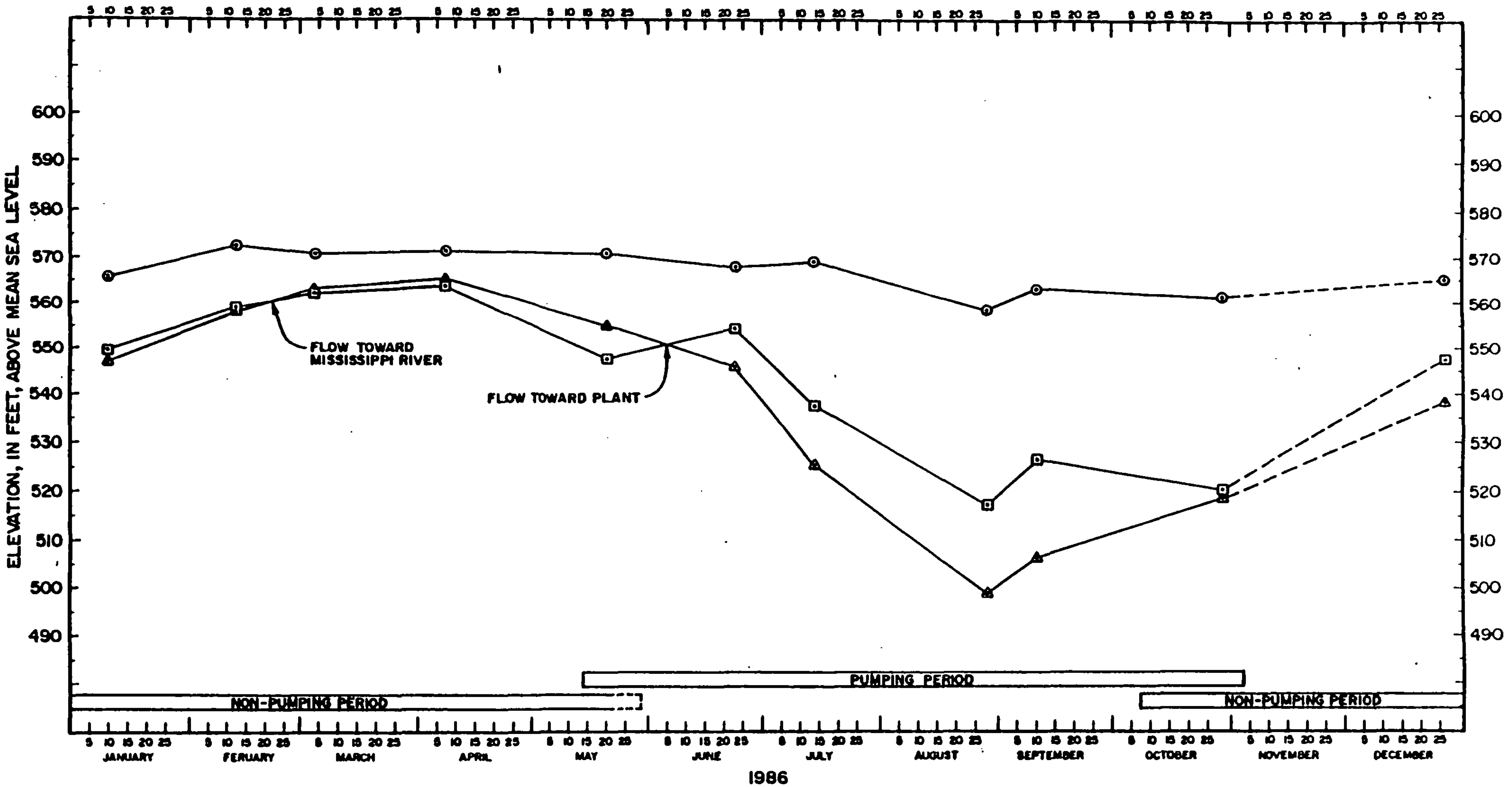
EXPLANATION

- GM-16 Monitor well
- 8 Collection well
- GM17R Replacement Well Installed April, 1989
- 564 Fluid Level Contour
- Ground-Water Flow direction

B-5 Ground-Water Flow Directions in the Monitor Wells at the Alcoa-Davenport Waste Site on August 15, 1989.



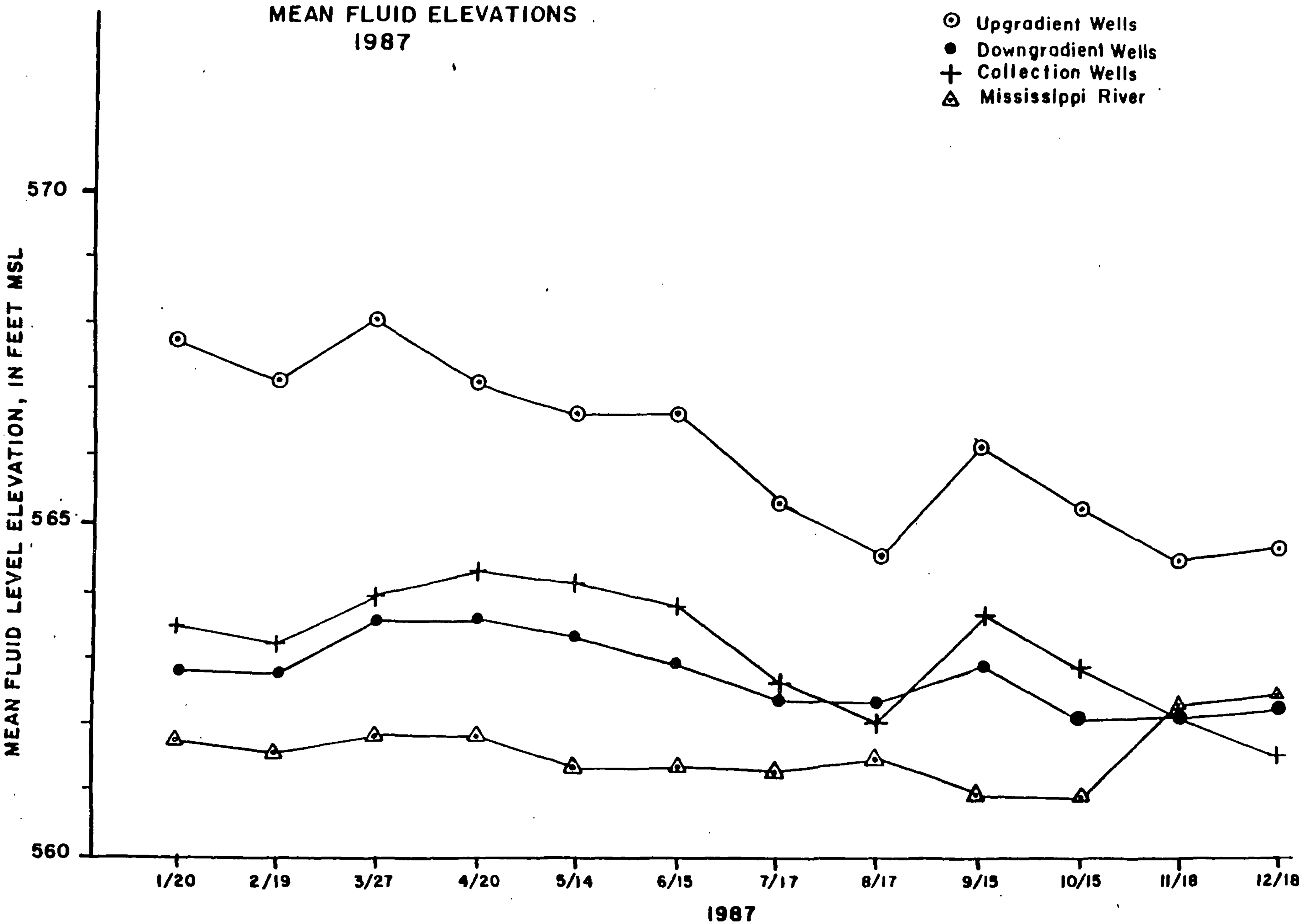
B-6 HYDROGRAPH OF WATER LEVELS FROM AS AND AI RELATIVE TO ALCOA PUMPING.



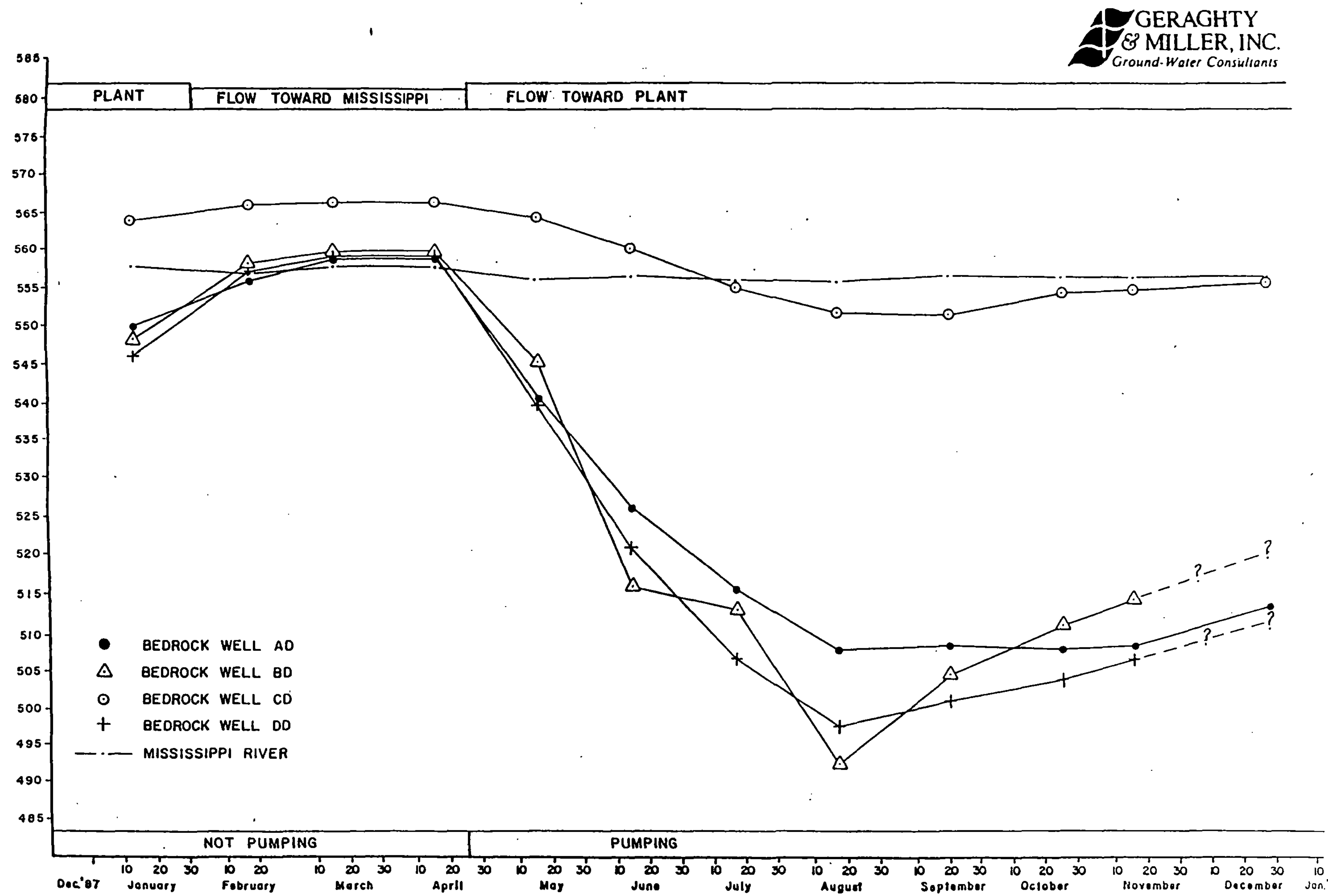
EXPLANATION

- ⊡ BEDROCK WELL AD
- △ BEDROCK WELL BD
- ⊙ BEDROCK WELL CD
- --- INDICATES NO DATA TAKEN IN NOVEMBER

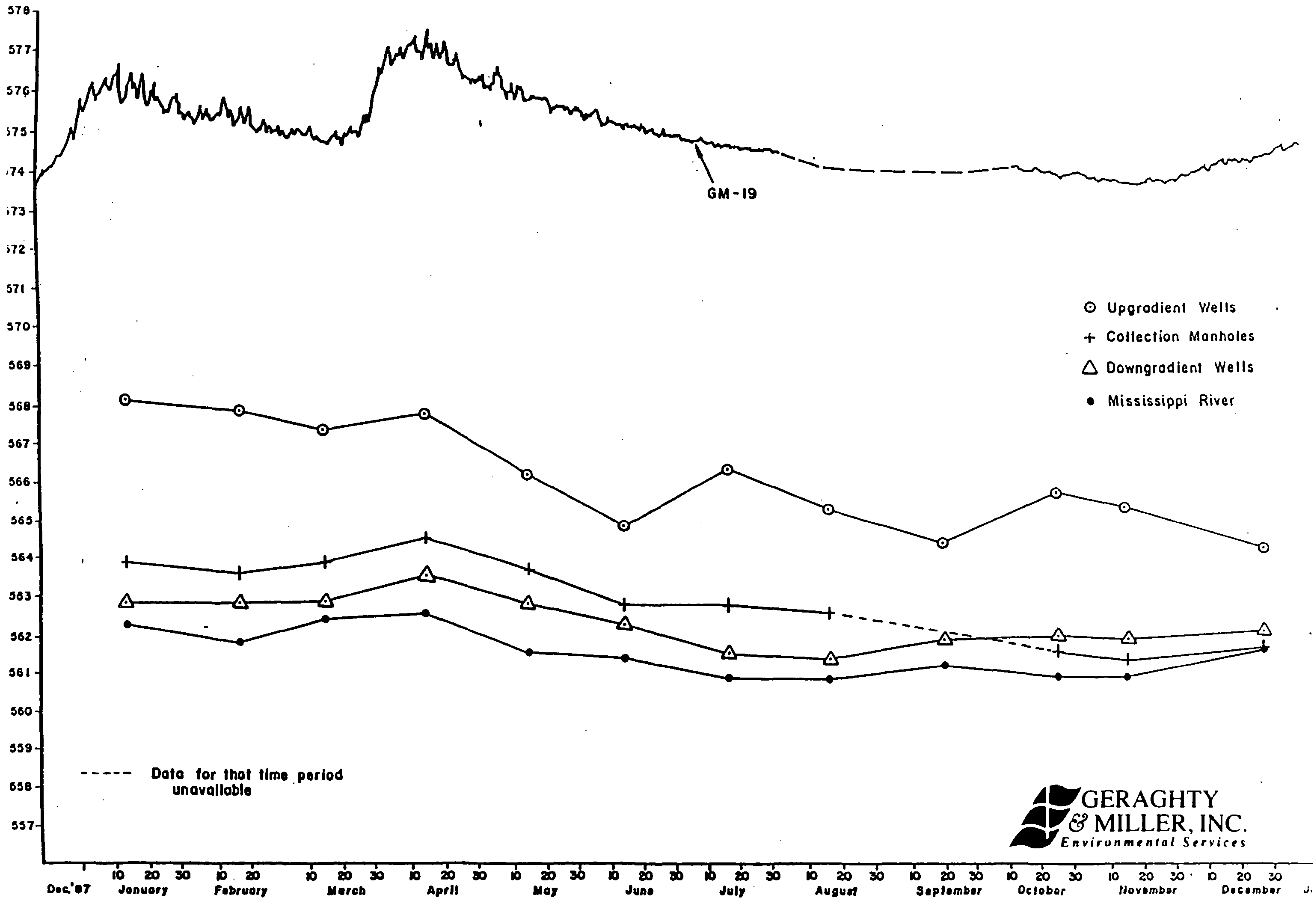
B-7 Hydrograph Depicting Annual Water-Level Fluctuation in Selected Bedrock Monitor Wells at the Alcoa-Davenport Plant.



B-8 Hydrograph Depicting Mean Fluid-Level Elevations for the Alcoa Waste Disposal Site and Mississippi River During 1987.



B-9 Hydrograph Depicting Water-Level Fluctuations in Selected Bedrock Monitoring Wells at the Alcoa-Davenport Plant During 1988.



B-10 Hydrograph Comparing Mean Water-Level Elevations of Monitoring Wells at the Alcoa-Davenport Waste Site to the Mississippi River.

APPENDIX C

Appendix C

Summary of Field Methodologies

FIELD METHODOLOGIES

A summary of the methodologies used to complete various components of the many field programs implemented at the Alcoa-Davenport site is provided herein. The methodologies discussed below address the drilling, well installation, sampling, measurement of water levels and oil thicknesses, slug tests, and pumping tests activities conducted at the Alcoa-Davenport site. Detailed discussions of the methodologies utilized are provided in the reports included on the list of references.

DRILLING AND WELL INSTALLATION

Waste-Site Monitor Wells and Borings

Waste-site wells and borings were completed using several types of truck mounted rotary rigs and hollow-stem augers. Soil samples were collected by driving 2-inch diameter, split-spoon samplers into the undisturbed stratum ahead of the lead auger. Several shallow waste-site wells were completed several feet into the uppermost bedrock surface. The bedrock portion of these wells was drilled using a 3-7/8-inch diameter tri-cone rotary bit and direct rotary drilling techniques. All soil and rock samples were visually identified and logged in the field by a G&M representative.

Upon reaching the desired depth, monitor wells consisting of 2-inch diameter PVC well casing and .010-inch slotted PVC well screen were installed through the hollow stem augers. The well screens were artificially sand packed and bentonite grout plugs were installed. Four-inch diameter locking steel, protective casings with caps were installed around the PVC casing, extending above the ground. Finally, a sloping concrete pad was installed at the base of the protective casing. No less than 48 hours after installation, the monitor wells were developed using various development techniques. All drilling and well installation materials were properly decontaminated before, and between usage in accordance with standard G&M protocol.

Bedrock Wells and Borings

To minimize the introduction of drilling fluids to the borehole, air-rotary drilling was used to complete the bedrock monitor wells. The unconsolidated upper unit was cased off and sealed prior to advancing downhole during the drilling of each bedrock hole, to eliminate the downward migration of fluids from the upper unit to the bedrock aquifer.

Permanent 4-inch diameter steel well casings were seated into the bedrock by pressure-grouting a cement-bentonite grout mixture through the inside of the well casings and into the borehole annulus, hydraulically sealing the cased portion of the wells. After the grout had solidified, the wells were completed by drilling through the inside of the well casing into the underlying bedrock to the desired depth. Water production is obtained from the uncased portion of each well which remains open to the bedrock strata. Upon completion, a locking cap was installed over the steel section of casing exposed at the surface. No less than 24 hours after completion, the wells were developed using air rotary techniques to displace a continuous flow of water from each well insuring their integrity as monitor wells.

Drilling and well installation material was properly decontaminated prior to each usage in accordance with standard G&M protocol.

GROUND-WATER SAMPLING PROCEDURES

Waste-Site Ground-Water Sampling

Collecting samples representative of the water phase only was complicated by the presence of a floating oil phase in some of the wells at the waste site. To overcome this obstacle, specialized telescoping sampling techniques were developed and implemented. Rigid 1.5-inch tubing was lowered into the wells below the oil-water interface. A cork was inserted into the base of the tubing to prevent oil from contaminating the interior of the tubing. This cork was knocked free of the tubing using a 1.25-inch diameter Teflon bailer only after lowering the base of the tubing below the oil-water interface. The cork was attached to the tubing using new nylon cord to facilitate the removal of the cork from the well upon completion of sampling. The outer tubing was constructed of 5-foot lengths of threaded PVC pipe. The lowermost section, in contact with the oil and water, was constructed of Teflon, for quality control purposes.

After the cork was displaced from the base of the tubing, water samples were collected using the 1.25-inch diameter Teflon bailer. One full bailer was typically removed from each well during evacuation, prior to sampling the well. Subsequently, representative water-phase samples were collected using this bailer.

During Phase III Monitoring, water-sampling techniques were modified due to the discontinuation of sampling for PCB analyses at the waste-site wells, and due to the decreasing oil thickness in perimeter wells at the waste site. The telescoping sampling technique was discarded and conventional sampling techniques employed. Specifically, a 3-foot long by 1.67-inch diameter Teflon bailer was used to evacuate three well volumes from each well. Upon recovery of fluid levels in the wells, samples were subsequently collected from the wells for VOC analyses only, using the same Teflon bailer.

Similar quality control procedures were utilized for all sampling methods implemented at the waste site. Prior to sampling each well, all equipment used in the well was initially decontaminated using a methanol rinse. Subsequent decontamination procedures included the application of a laboratory grade detergent wash followed by a distilled water rinse and a final deionized water rinse. Additional quality control procedures utilized included the collection and analysis of field blanks, duplicate samples and trip blanks. Chain of custody documents accompanied the samples at all times.

Bedrock Ground-Water Sampling

Prior to sampling, approximately three well volumes were evacuated from the shallow-most wells using a Teflon bailer. A minimum of one and one-half well volumes were evacuated from the deep and intermediate wells using a Grundfos stainless steel submersible pump. As the pump was lowered into each well, the discharge tubing was cleaned with a fresh cloth saturated with deionized water. After evacuation and pump removal, approximately one gallon was bailed from each well prior to collecting the ground-water samples. The samples were extracted using a bottom-filling Teflon bailer. Field measurements of pH, specific conductance and temperature were collected from each well at the time of sampling. For quality control purposes, field blanks and duplicate samples were collected, and a trip blank was provided by the laboratory.

Chain-of-custody documentation accompanied all of the samples at all times until delivery of the samples to the laboratory. All of the water samples were shipped via an overnight courier service to the laboratory, within a 12-hour period. All sampling methodology was conducted following G&M sampling protocol.

FLUID LEVEL AND OIL THICKNESS MEASUREMENTS

Water-Level Measurements

Fluid levels at the waste site were measured using a stainless steel tape measure calibrated in tenths of a foot. The tape was lowered into the well between one and two feet below the fluid level. For each well, a measurement was taken at the surveyed measuring point (MP) on the well casing. The tape was then withdrawn; and, the wet/dry boundary was noted on the tape. This value was subtracted from the measuring point value to obtain the depth-to-water. Subtracting the depth-to-water value from the (MP) elevation yielded the elevation of the water table in each well. Water levels were measured in the bedrock monitor wells and plant process-water wells using an electronic water-level device calibrated in fee (0.20-foot increments) and in meters. Upon reaching the water surface in the well, the electronic sensing device was activated and the depth-to-water read directly from the electronic sensing device. Subtracting this depth-to-water value from the MP eleviation provided the elevation of the potentiometric surface of the bedrock aquifer in the vicinity of the well.

Oil-Thickness Measurements

Oil-thickness measurements are collected from the waste site monitor wells via a clear, bottom-filling acrylic interface bailer incremented in inches and in centimeters. The bailer is lowered into the column of fluid in each well without submerging the top of the bailer below the fluid surface. Upon retrieval, the fluid is visually observed to determine if any oil is present and if so, to measure its thickness. This bailer is dedicated for use solely in the shallow monitor wells and collection manholes to avoid cross-contamination of the bedrock wells.

AQUIFER TESTING

Aquifer testing was conducted in several locations on the plant site to determine aquifer properties. Both pumping tests and slug tests were conducted for this purpose.

Slug Tests

The slug tests were performed by lowering a Teflon bailer into the well and allowing the water level to equilibrate to the original level. The bailer was then quickly removed, with water levels recorded until the water-level had equilibrated. Slug test equipment was decontaminated between wells to prevent cross contamination.

Pumping Tests

Pumping tests of varying lengths were conducted in several locations at the Alcoa Plant. Each test consisted of pumping one well, in most cases a production well, and monitoring drawdown in neighboring wells. Recovery data was also collected for each test.

Pre-test water levels were monitored prior to conducting the pumping tests. Barometric pressure was also monitored prior to and during the test. Pumping rates were monitored and recorded. Discharge water was channeled to pre-determined locations to control runoff.

APPENDIX D

Appendix D

Supplemental Site Water Quality Analyses

APPENDIX D

TABLE D-1
SUMMARY OF ALL PCB ANALYTICAL DATA
FOR WATER SAMPLES COLLECTED FROM
SHALLOW MONITOR WELLS AT THE
ALCOA WASTE SITE

	1981					1982											
WELL NO.	MAR.[1]	APR.[1]	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC
GM-1	.073	---	.008						.036						.003		
GM-2	.004	---	.010						.029						---		
GM-3			.004						.002						.016		
GM-4	.109	.265	.028						---						.068		
GM-5		408	.400	1.800	1.400		IW	.110	.230	.049	.055	.081	.028	.979	.724	.244	.06
GM-6	57	67	IW	.122	1.300	.650	IW	.770	.008	.027	.054	1.000	.136	1.400	.936		
GM-7		.106	.170	.430	.300	.025	.010	.008	.083	.002	.002	.015	.005	.002	.003		
GM-8	.010	.011	.020						.007						.009		
GM-8D		.004	.008						.001						.003		
GM-9	.272	.098	.180						.174						.016		
GM-10	.082	30	.041						.011						.105		
GM-11	1.180	104	8.300						.790						.007		
GM-12	.306	.108	.099						.001						.063		
GM-13																	
GM-14		.205	.032		.010		.008		.001		.005		.013		.010		.001
GM-15			.002						.006						.003		.001
GM-16	.013	.019	.004		---		.001		.003		.001		.002		.003		
AS																	
B-1			---														
B-2	.003								---						---		
B-3	.006		.003						.002						.002		
B-4									---								

Notes:
All Concentrations Reported In ppm
[1]Samples Collected In March and April 1981 Are Composite Samples Which Contain Oil, Water, Sediment, Or Any Combination Of These Three Phases
--- = Not Present Above Laboratory Detection Limits
Blank Space Indicates That A Sample Was Not Collected For PCB Analysis
X=Sediment Phase Not Present In Well
Wells GM-17 through GM-19, And GM-20 Through GM-23 Were Installed During February 1982 and September 1984, respectively, And Utilized For Fluid-Level And Oil-Thickness Monitoring.

TABLE D-1 (CONTINUED)
SUMMARY OF ALL PCB ANALYTICAL DATA
FOR WATER SAMPLES COLLECTED FROM
SHALLOW MONITOR WELLS AT THE
ALCOA WASTE SITE

	1983												1984			
WELL NO.	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.
GM-1				.002						.062						.295
GM-2				.001						---						.005
GM-3				.420						.064						.040
GM-4				.010						.032						.009
GM-5	.440	2.804	3.000	.700	2.020	1.290	17.500	4.570	3.770	1.812			1.240	1.261	2.780	.860
GM-6	3.178	1.230	2.900	3.900	4.470	3.100	2.520	2.130	1.670	.970			1.650	2.189	1.075	.819
GM-7	.660	---	.510	.037	.003	.190	.011	.002	.007	.009			.005	.010	.107	.014
GM-8				.005						.001						.017
GM-8D				.620						.012						.011
GM-9				.008						.009						.005
GM-10				.004						.096						.129
GM-11				10.000						.063						2.289
GM-12				.026						.420						.732
GM-13				.037												
GM-14		.001		.002		.002	.001		.006	.055				.001		.005
GM-15				.002						.004						.001
GM-16		.002		.002		.001	---		.001	---				.001		.002
AS																
B-1																
B-2				---						---						---
B-3										.001						---
B-4										.001						---

Notes:
All Concentrations Reported In ppm
[1]Samples Collected In March and April 1981 Are Composite Samples Which Contain Oil, Water, Sediment, Or Any Combination Of These Three Phases
--- = Not Present Above Laboratory Detection Limits
Blank Space Indicates That A Sample Was Not Collected For PCB Analysis
X=Sediment Phase Not Present In Well
Wells GM-17 through GM-19, And GM-20 Through GM-23 Were Installed During February 1982 and September 1984, respectively, And Utilized For Fluid-Level And Oil-Thickness Monitoring.

TABLE D-1 (CONTINUED)
SUMMARY OF ALL PCB ANALYTICAL DATA
FOR WATER SAMPLES COLLECTED FROM
SHALLOW MONITOR WELLS AT THE
ALCOA WASTE SITE

	1986	1987		1988	
WELL NO.	OCTOBER	APRIL	OCTOBER	MAY	OCTOBER
GM-1					
GM-3					
GM-4	.017	.011	.041	.082	.340
GM-5					
GM-6	IW	.410	18.000	6.700	IW
GM-7					
GM-8					
GM-8D					
GM-9					
GM-10	.036	.210	4.200 (1.500)	.850	IW
GM-11					
GM-12	.212	.120	.190	.230	.300
GM-13					
GM-14					
GM-15					
GM-16					
AS	.0029	.0052	.012	.0044	.025
B-1					
B-2					
B-3					
B-4					

Notes:
All Concentrations Reported in ppm
[1]Samples Collected in March and April 1981 Area Composite Samples Which Contain Oil, Water, Sediment, Or Any Combination Of These Three Phases
--- = Not Present Above Laboratory Detection Limits
Blank Space Indicates That A Sample Was Not Collected For PCB Analysis
IW = Insufficient Water Available For Sampling
Well GM-17 through GM-19, and GM-20 Through GM-23 Were Installed During February 1982 and September 1984, respectively, And Utilized For Fluid-Level and Oil-Thickness Monitoring.
(1.500)*= Results of Sample Certrifuged Prior to Analysis

TABLE D-2
SUMMARY OF ALL PCB ANALYTICAL DATA
FOR SEDIMENT SAMPLES COLLECTED FROM
SHALLOW MONITOR WELLS AT THE
ALCOA WASTE-DISPOSAL SITE

	1981					1982											
WELL NO.	MAR.[1]	APR.[1]	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC
GM-1	.073	---	12						130						18		
GM-2	.004	---	7						X						5		
GM-3			X						X						2		
GM-4	.109	.265	62						9						99		
GM-5		408	810	X	59		X	530	160	X	2070	1000	X	X	X	X	X
GM-6	57	67	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
GM-7		.106	51	213	4560	58	93	160	51	26	25	110	65	19	104	64	188
GM-8	.010	.011	26						8						7		
GM-8D		.004	140						26						114		
GM-9	.272	.098	85						X						118		
GM-10	.082	30	210						260						13		
GM-11	1.180	104	2000						140						1346		
GM-12	.306	.108	270						120						6620		
GM-13																	
GM-14		.205	230		110		260		79		97		90		86		569
GM-15			16						24						138		
GM-16	.013	.019	28		18		5		6		11		11		17		X
AS																	
B-1			X														
B-2	.003								X						X		
B-3	.006		X						9						20		
B-4									10								

Notes:
All Concentrations Reported In ppm
[1]Samples Collected In March and April 1981 Are Composite Samples Which Contain Oil, Water, Sediment, Or Any Combination Of These Three Phases
--- = Not Present Above Laboratory Detection Limits
Blank Space Indicates That A Sample Was Not Collected For PCB Analysis
X=Sediment Phase Not Present In Well
Wells GM-17 through GM-19, And GM-20 Through GM-23 Were Installed During February 1982 and September 1984, respectively, And Utilized For Fluid-Level And Oil-Thickness Monitoring.

TABLE D-2 (CONTINUED)
SUMMARY OF ALL PCB ANALYTICAL DATA
FOR SEDIMENT SAMPLES COLLECTED FROM
SHALLOW MONITOR WELLS AT THE
ALCOA WASTE-DISPOSAL SITE

	1983												1984			
WELL NO.	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.
GM-1				X						X						X
GM-2				5						.05						1
GM-3				X						X						X
GM-4				69						X						X
GM-5	X	X	X	X	X	X	X	X	X	X			1700	X	52	1130
GM-6	X	X	X	X	X	X	X	X	X	X			X	X	X	X
GM-7	X	X	X	X	X	X	X	X	X	X			17	X	X	X
GM-8				9						X						X
GM-8D				X						.12						X
GM-9				X						X						25
GM-10				100						X						X
GM-11				X						X						944
GM-12				410						X						X
GM-13				X												X
GM-14		X		1300		X	X		X	X				X		X
GM-15				40						X						X
GM-16		X		X		X	X		X	X				X		10
AS																
B-1																
B-2				X						X						X
B-3										.04						X
B-4										X						X

Notes:
All Concentrations Reported In ppm
[1]Samples Collected In March and April 1981 Are Composite Samples Which Contain Oil, Water, Sediment, Or Any Combination Of These Three Phases
--- = Not Present Above Laboratory Detection Limits
Blank Space Indicates That A Sample Was Not Collected For PCB Analysis
X=Sediment Phase Not Present In Well
Wells GM-17 through GM-19, And GM-20 Through GM-23 Were Installed During February 1982 and September 1984, respectively, And Utilized For Fluid-Level And Oil-Thickness Monitoring.

TABLE D-3
SUMMARY OF ALL PCB ANALYTICAL DATA
FOR OIL SAMPLES COLLECTED FROM
SHALLOW MONITOR WELLS AT THE
ALCOA WASTE-DISPOSAL SITE

	1981					1982											
WELL NO.	MAR.[1]	APR.[1]	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC
GM-1	.073	---	5						X						38		
GM-2	.004	---	X						X						X		
GM-3			X						X						X		
GM-4	.109	.265	X						X						X		
GM-5		408	2400	6200	6700		6400	4100	5900	5600	4340	6900	6300	5640	5723	5650	5333
GM-6	57	67	10000	7200	7400	7500	6600	5700	6500	X	4590	7800	7300	6340	6562	6250	6513
GM-7		.106	X			X	X	X	X	X	X	X	X	X	X		
GM-8	.010	.011	X						X		X				X		
GM-8D		.004	X						X		X				X		
GM-9	.272	.098	X						X						X		
GM-10	.082	30	X						X						X		
GM-11	1.180	104	15000						X						7180		
GM-12	.306	.108	X						X						X		
GM-13																	
GM-14		.205	X		X		X		X						X		X
GM-15			X						X						X		
GM-16	.013	.019	X		X		X		X						X		X
AS																	
B-1			X														
B-2	.003								X						X		
B-3	.006		X						X						X		
B-4									X								

Notes:
All Concentrations Reported In ppm
[1]Samples Collected In March and April 1981 Are Composite Samples Which Contain Oil, Water, Sediment, Or Any Combination Of These Three Phases
--- = Not Present Above Laboratory Detection Limits
Blank Space Indicates That A Sample Was Not Collected For PCB Analysis
X=Oil Phase Not Present In Well
Wells GM-17 through GM-19, And GM-20 Through GM-23 Were Installed During February 1982 and September 1984, respectively, And Utilized For Fluid-Level And Oil-Thickness Monitoring.

TABLE D-3 (CONTINUED)
SUMMARY OF ALL PCB ANALYTICAL DATA
FOR OIL SAMPLES COLLECTED FROM
SHALLOW MONITOR WELLS AT THE
ALCOA WASTE-DISPOSAL SITE

	1983												1984			
WELL NO.	JAN.	FEB.	MAR.	APR.	MAY.	JUN.	JUL.	AUG.	SEP.	OCT.	NOV.	DEC.	JAN.	FEB.	MAR.	APR.
GM-1				X						7						X
GM-2				X						X						X
GM-3				X						X						X
GM-4				X						X						X
GM-5	6090	4420	5200	73	5780	5050	5350	5800	5500	4410			3950	4175	5129	3493
GM-6	7040	5120	5900	5700	6540	6030	6490	6200	6700	5150			4370	10170	5596	4088
GM-7		930	X	X	X	X	X	X	X	X			X	X	X	X
GM-8				X						X						X
GM-8D				X						X						X
GM-9				X						X						X
GM-10				X						X						X
GM-11				5040						X						4076
GM-12				4700						3500						120
GM-13				X												X
GM-14		X		X		X	X		X	X				X		X
GM-15				X						X						X
GM-16		X		X		X	X		X	X				X		X
AS																
B-1				X						X						
B-2										X						X
B-3										X						X
B-4																X

Notes:
All Concentrations Reported In ppm
[1]Samples Collected In March and April 1981 Are Composite Samples Which Contain Oil, Water, Sediment, Or Any Combination Of These Three Phases
--- = Not Present Above Laboratory Detection Limits
Blank Space Indicates That A Sample Was Not Collected For PCB Analysis
X=Oil Phase Not Present In Well
Wells GM-17 through GM-19, And GM-20 Through GM-23 Were Installed During February 1982 and September 1984, respectively, And Utilized For Fluid-Level And Oil-Thickness Monitoring.

TABLE D-4

PRIORITY POLLUTANT COMPOUNDS ANALYZED IN GROUND-WATER SAMPLES FROM THE ALCOA, DAVENPORT BEDROCK WELLS

	Detection Limit (ug/l)
Volatile Organics	
Chloromethane	10
Vinyl Chloride	10
Chloroethane	10
Bromomethane	10
Acrolein	100
Acrylonitrile	100
Methylene Chloride	10
Trichlorofluoromethane	10
1,1-Dichloroethylene	10
1,1-Dichloroethane	10
trans-1,2-Dichloroethylene	10
Chloroform	10
1,2-Dichloroethane	10
1,1,1-Trichloroethane	10
Carbon Tetrachloride	10
Bromodichloromethane	10
1,2-Dichloropropane	10
trans-1,3-Dichloropropene	10
Trichloroethylene	10
Benzene	10
cis-1,3-Dichloropropene	10
1,1,2-Trichloroethane	10
Dibromochloromethane	10
Bromoform	10
1,1,2,2-Tetrachloroethylene	10
1,1,2,2-Tetrachloroethane	10
Toluene	10
Chlorobenzene	10
Ethylbenzene	10
2-Chloroethyl Vinyl Ether	10
Dichlorodifluoromethane	
Bis(Chloromethyl)Ether	

	Detection Limit (ug/l)
Base-Neutral Extractable Organics	
N-Nitrosodimethylamine	10
Bis (2-Chloroethyl) Ether	10
1,3-Dichlorobenzene	10
1,4-Dichlorobenzene	10
1,2-Dichlorobenzene	10
Bis (2-Chloroisopropyl) Ether	10
Hexachloroethane	10
N-Nitrosodi-N-Propylamine	10
Nitrobenzene	10
Isophorone	10
Bis(2-Chloroethoxy) Methane	10
1,2,4-Trichlorobenzene	10
Naphthalene	10
Hexachlorobutadiene	10
Hexachlorocyclopentadiene	10
2-Chloronaphthalene	10
Dimethylphthalate	10
Acenaphthyene	10
2,6-Dinitrotoluene	10
Acenaphthene	10
2,4-Dinitrotoluene	10
Diethylphthalate	10
Fluorene	10
4-Chlorophenyl Phenyl Ether	10
Diphenylamine (N-Nitroso)	10
1,2-Diphenylhydrazine (Azobenzene)	10
4-Bromophenyl Phenyl Ether	10
Hexachlorobenzene	10
Phenanthrene	10
Anthracene	10
Di-N-Butylphthalate	10
Fluoranthene	10
Benzidine	10
Pyrene	10
Butylbenzylphthalate	10
Benzo(A)Anthracene	10
3,3'-Dichlorobenzidine	10
Chrysene	10
Bis(2-Ethyhexyl)Phthalate	10
Di-N-Octylphthalate	10
Benzo(B)Fluoranthene	10
Benzo(K)Fluoranthene	10
Benzo(A)Pyrene	10
Indeno(1,2,3-C,D)Pyrene	10
Dibenzo(A,H)Anthracene	10
Benzo(G,H,I)Perylene	10

	Detection Limit (ug/l)
Pesticides/PCBs	
Aldrin	0.10
Alpha-BHC	0.10
Beta-BHC	0.10
Gamma-BHC	0.10
Delta-BHC	0.10
Chlordane	0.10
4,4'-DDT	0.10
4,4'-DDE	0.50
4,4'-DDD	0.10
Dieldrin	0.10
Endosulfan I	0.10
Endosulfan II	0.10
Endosulfan Sulfate	0.10
Endrin	0.10
Endrin Aldehyde	0.10
Heptachlor	0.10
Heptachlor Epoxide	0.10
PCB-1242	1.0
PCB-1254	1.0
PCB-1221	1.0
PCB-1232	1.0
PCB-1248	1.0
PCB-1260	1.0
PCB-1016	1.0
Toxaphene	1.0
Acid Extractables	
Phenol	25
2-Chlorophenol	25
2-Nitrophenol	25
2,4-Dimethylphenol	25
2,4-Dichlorophenol	25
P-Chloro-M-Cresol	25
2,4,6-Trichlorophenol	25
2,4-Dinitrophenol	250
4-Nitrophenol	25
4,6-Dinitro-O-Cresol	250
Pentachlorophenol	25

TABLE D-5.
METALS AND NON-METAL COMPOUNDS ANALYZED
IN THE DECEMBER 1985 SAMPLES FROM THE
ALCOA-DAVENPORT PLANT WELLS

	Analytical Methods	
	EPA, 1979[1]	Standard Methods[2]
Alkalinity, Total ($CaCO_3$)		403
Aluminum	202.1	
Antimony	204.1	
Arsenic	206.3	
Beryllium	210.1	
Cadmium	213.1	
Calcium	215.1	
Chloride		407b
Chromium, Total		503a
Copper	220.1	
Iron	236.1	
Lead		303a
Magnesium	242.1	
Manganese	243.1	
Mercury		303f
Nickel	249.1	
Nitrate	353.3	
Potassium	256.1	
Selenium	270.3	
Silver	272.1	
Sodium	273.1	
Solids, Dissolved		209b
Sulfate	375.4	
Thallium	279.1	
Zinc	289.1	

1 Methods for Chemical Analysis of Water and Wastes, 1979, EPA 600/4-79-020.

2 Standard Methods for the Examination of Water and Waste-water, 15th Edition, 1980.

TABLE D-6.
ANALYTICAL RESULTS OF UNFILTERED GROUND-WATER SAMPLES TAKEN IN DECEMBER, 1985,
FROM THE ALCOA-DAVENPORT PLANT WELLS

	AI	AD	AS	BI (mg/l)	BD	CI	CD
Alkalinity, Total ($CaCO_3$)	281	228	412	347	334	180	384
Aluminum	62.1	0.1	0.6	7.0	0.2	<0.1	0.1
Antimony	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Arsenic	0.005	<0.002	<0.002	<0.002	<0.002	0.003	<0.002
Beryllium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Cadmium	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Calcium	110	60	152	126	104	152	95
Chloride	27	11	163	130	11	195	33
Chromium, Total	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Copper	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Iron	47.0	5.27	5.20	12.5	9.83	36.0	11.2
Lead	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	<0.05
Magnesium	52.7	27.4	70.4	43.8	39.3	58.9	41.4
Manganese	0.53	0.08	0.76	0.15	0.12	0.44	0.25
Mercury	<0.0002	0.0008	<0.0002	<0.0002	0.0007	<0.0002	0.0007
Nickel	0.13	<0.04	<0.04	0.05	<0.04	<0.04	<0.04
Nitrate	0.07	0.64	0.05	5.52	2.24	0.11	<0.05
Potassium	28.0	0.81	16.9	11.8	1.15	1.69	0.54
Selenium	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Silver	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Sodium	53.0	21.0	88.0	76.0	27.0	91	35.0
Solids, Dissolved	519	375	1720	885	487	1051	495
Sulfate	79	10	510	214	45	198	23
Thallium	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Zinc	0.072	0.040	0.015	0.021	0.119	0.087	0.014

APPENDIX E

Appendix E

Fate and Transport of Waste Site Contaminants

APPENDIX E

Physical and Chemical Properties Affecting Fate and Transport of Contaminants at the Waste Site

The fate and transport of the waste-site contaminants addressed within this report are affected by their physical and chemical properties. Table E-1 lists some of these properties for the following waste-site contaminants: chloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, PCBs (specifically Aroclor 1248), toluene, trichloroethene, and vinyl chloride. Although tetrachloroethene was detected in the bedrock aquifer only and not at the waste site, it is also included in this discussion.

The physical and chemical properties considered in this report include: water solubility, specific gravity, vapor pressure, Henry's Law Constant, organic carbon distribution coefficient (K_{oc}), octanol-water partition coefficient (K_{ow}), fish bioconcentration factor (BCF), and half-life. Water solubility is the maximum or saturated concentration of a chemical in pure water at a specific temperature. Specific gravity is the ratio of the density of a chemical to the density of water. Vapor pressure is a property of a chemical in its pure state and is an important indication of the volatility of a chemical. Henry's Law Constant is the air/water partition coefficient of a chemical which relates its concentration in the gas phase to its concentration in the water phase. It can be used to calculate the rate of evaporation of a chemical from water. K_{oc} is a measure of the tendency for organic chemicals to be adsorbed by soil and sediment; K_{ow} is a measure of the distribution of a chemical, at equilibrium, between octanol and water. The BCF is a measure of the tendency for a chemical in water to concentrate in fish tissue. The half-life (T 1/2) is the time required for the concentration of a chemical to be reduced by a factor of two.

The relative significance of each fate and transport mechanism for the contaminants is summarized in Table E-2. Fate and transport mechanisms will be discussed for the halogenated aliphatics, toluene, and PCBs in general. Chloroethane, 1,1-dichloroethane, 1,2-dichloroethene, tetrachloroethene, trichloroethene and vinyl chloride belong to a class of chemicals known as halogenated aliphatics, and as such, behave very similarly in the environment. Therefore, fate and transport of halogenated aliphatics will be presented in a general discussion.

Halogenated Aliphatic Compounds

The halogenated aliphatic compounds detected at the waste site are chloroethane, 1,1-dichloroethane, 1,1-dichloroethene, 1,2-dichloroethene, trichloroethene, and vinyl chloride. In addition, the halogenated compound tetrachloroethene was detected in the bedrock aquifer. In general, these compound have relatively high aqueous solubilities and vapor pressures, low soil adsorption characteristics (K_{oc}), extremely slow hydrolysis rates, and relatively rapid oxidation rates (Table E-2). It is likely, therefore, that the halogenated aliphatics dissolved in ground water will degrade slowly due to their low hydrolysis rates but should be relatively mobile in ground water due to their high solubilities. Upon release or removal from the ground-water environment, the degradative pathway is volatilization and degradation in the troposphere through photo- or chemical oxidation. The BCFs for these compounds are quite low and range from 1.17 to 31 (Table E-1). Thus, the potential for the halogenated aliphatics detected at the waste site to bioaccumulate in organisms at successive trophic levels is considered minimal.

Toluene

Toluene is primarily released by volatilization from soils and surface water to the air where it undergoes photooxidation to cresols and benzaldehyde. Volatilization rates from soil and water vary; however, reported half-lives from water range between 5 hours and 16 days (Mackay and Leinonen, 1975; Wakeham et al., 1983).

Toluene not lost through volatilization is subject to microbial degradation in both soil and water. Under optimum conditions the half-life for aquatic biodegradation can be one day or less (Wakeham et al., 1983). Biodegradation is not a major removal mechanism under the anoxic conditions commonly encountered in ground water. However, with the addition of oxygen, nutrients and an adapted population of microorganisms, biodegradation rates can rise significantly (Wilson et al., 1983). Based on the octanol/water partition coefficient, moderate adsorption to soil is predicted. Bioaccumulation is not significant (USEPA, 1979).

PCBs

Based on the number and position of chlorines on the biphenyl ring, there are 209 possible isomers and congeners of PCBs. Aroclor was the trade name for commercial PCB mixtures produced in the United States. Different mixtures were designated by a four digit numbering system, e.g., Aroclor 1248. The first two digits indicate that there are 12 carbons in the biphenyl ring, and the last two digits indicate the approximate percentage of chlorine in the mixture. Each Aroclor mixture contains many PCB isomers and congeners. The position and number of chlorines on the biphenyl ring affect the environmental fate and transport.

Volatilization, adsorption, bioaccumulation, and anaerobic and aerobic dechlorination are the major factors affecting the environmental fate and transport of PCBs. Because of differences in physical and chemical properties among the various PCB congeners, PCB mixtures detected in the environment differ from the original commercial mixtures, and also differ with respect to environmental compartment or trophic level. Generally, PCBs in air samples contain a higher proportion of the less chlorinated congeners than those found in sediments or soils. Congeners found in biota generally contain a higher percentage of the more chlorinated congeners (USEPA, 1979). Environmental cycling of PCBs occurs through volatilization. This cycling process has distributed PCBs throughout the environment and is likely the current major source of PCB release (Larsson, 1985; Swackhamer and Armstrong, 1986).

Based on vapor pressure alone, PCBs would not be considered volatile, but volatilization from water is significant because of low solubility and a relatively high Henry's Law Constant (Tofflemire et al., 1983). Volatilization can also be the major route of PCB release from lakes (Swackhamer and Armstrong, 1986). However, adsorption to suspended sediments will reduce volatilization rates significantly.

Low water solubilities and high octanol/water partition coefficients (K_{ow}) result in a high affinity of PCBs for soil and sediment. PCBs will strongly adsorb to soil or sediment with relatively high organic matter or clay contents (Haque et al., 1974; USEPA, 1979). Significant leaching would not be likely under most conditions. Sediments act as sinks for deposition of PCBs; however, resuspension and resolution can result in volatilization (Fisher et al., 1983; Swackhamer and Armstrong, 1986). The congeners with higher chlorine content generally will have the highest affinity for adsorption due to lower solubility and higher K_{ow}s. As described in Section 6.2.2, the solubility of PCBs has been evaluated for this waste site (ATC, 1988). The solubility ranges from 18 to 54 μg/L; a value of 18 μg/L has been used in calculations.

Bioconcentration factors for PCBs range between 10^4 and 10^6 liters per kilogram (L/kg) (USEPA, 1979). PCBs can be passed along the food chain or absorbed directly from the water column by aquatic species (Muir et al., 1988; Oliver and Niimi, 1988). PCB concentrations have been demonstrated to increase with trophic level and lipid content of the organism. The chlorine content of

PCBs also generally increases with trophic level (Oliver and Niimi, 1988).

Plants may accumulate PCBs from the air; however, available data indicate that uptake from the soil and translocation to stems and leaves is not significant (Tofflemire et al., 1983). Studies with corn and goldenrod have shown that less than one percent of PCBs entering the roots are translocated to stems and leaves over a growing season (Buckley, 1982).

PCB congeners with less than five chlorine atoms are susceptible to biodegradation while those with more than five are generally resistant (USEPA, 1979). Recent studies have shown that reductive dechlorination of the higher chlorinated congeners can occur in aquatic sediments. The dechlorinated products formed are generally less toxic and are subject to aerobic biodegradation (Brown et al., 1987; Quensen et al., 1988).

TABLE E-1
PHYSICAL AND CHEMICAL PROPERTIES OF CONTAMINANTS DETECTED
AT THE ALCOA WASTE SITE, RIVERDALE, IOWA.

Contaminant	Molecular Weight (g/mol)	Water Solubility (mg/L)	Specific Gravity	Vapor Pressure (mm Hg)	Henry's Law Constant (ATM-m^3/mol)	K_{oc} (ml/g)	Log K_{ow}	Fish BCF (L/kg)	Water T 1/2 (days)
Benzene	78	1.750	0.88	95	5.6 E-3	83	2.12	5.2	<1-6
Bromodichloromethane	164	NA	1.971	50	NA	NA	1.88	NA	NA
Chloroethane	65	5,740	0.92	1000	1.11 E-02	33-143	1.54	5-7	0.1
Chloroform	119	8,200	1.483	151	2.87 E-03	31	1.9	3.75	0.3 - 30
1,1-Dichloroethane	99	5,500	1.178	182	4.31 E-03	30	1.79	12	1.0 - 5.0
1,1-Dichloroethene	97	2,250	1.218	600	3.4 E-02	65	1.84	5.6	1.0 - 6.0
1,2-Dichloroethene (trans)	97	6,300	1.256	324	6.56 E-03	59	0.48	1.6	1.0 - 3.0
1,2-Dichloroethene (cis)	97	3,500	1.28	208	7.58 E-03	49	0.70	1.6	1 - 6
PCBs 1248	300	0.06	1.41	4.9 E-04	2.8 E-04	530,000*	6.2	100,000*	2 - 13
PCBs 1260	376	0.0027	1.58	4.0 E-05	4.6 E-03	530,000*	6.8	100,000*	2 - 13
Tetrachloroethene	166	150	1.62	18	2.59 E-02	364	2.86	31	1 - 30
Toluene	92	535	0.8669	28.1	6.37 E-03	300	2.73	10.7	0.17
Trichloroethene	131	1,100	1.46	60	9.10 E-03	126	2.38	10.6	1 - 90
Vinyl chloride	63	2,763	0.91	2660	1.07 E-02	57	1.38	1.17	1 - 5

*	For PCBs in general.	L/kg	Liters per kilogram.
ATM-m^3/mol	Atmospheres-meter cubed per mole.	mg/L	Milligrams per liter.
BCF	Bioconcentration Factor.	mm Hg	Millimeters of mercury.
g/mole	Grams per mole.	ml/g	Milliliters per gram.
K_{oc}	Organic Carbon Partition Coefficient.	NA	Not available.
K_{ow}	Octanol-Water Partition Coefficient.	T 1/2	Half-life.

GERAGHTY & MILLER, INC.
Environmental Services

References: ATSDR, 1987; Howard, 1989; USEPA, 1986a; USEPA, 1979; Verschueren, 1983; Weast, 1981; Windholtz and Budavari, 1983

TABLE E-2

SIGNIFICANCE OF FATE AND TRANSPORT MECHANISMS
FOR CONTAMINANTS DETECTED AT THE
ALCOA WASTE SITE, RIVERDALE, IOWA

Contaminant	Photolysis	Oxidation	Hydrolysis	Volatilization	Sorption	Bioaccumulation	Biotransformation/ Biodegradation
Bromodichloromethane[a]	NS	Primary	NS	Primary	Low	Low	Low
Chloromethane	NS	Low	Probable	Primary	NS	NS	Low
Chloroform	NS	Primary	NS	Primary	Low	Low	Low
1,1-Dichloroethane	NS	Primary	NS	Primary	NS	NS	Low
1,1-Dichloroethene	NS	Primary	NS	Primary	NS	NS	Low
1,2-Dichloroethene (trans)	NS	Primary	NS	Primary	NS	NS	Low
1,2-Dichloroethene (cis)	NS	Primary	NS	Primary	NS	NS	Low
PCBs	Low	NS	NS	Primary	Primary	High	Low
Tetrachloroethene	NS	Primary	NS	Primary	NS	Moderate	Moderate
Toluene	NS	Primary	NS	Primary	Moderate	Moderate	Moderate
Trichloroethene	NS	Primary	NS	Primary	NS	Low	Low
Vinyl chloride	NS	Primary	NS	Primary	NS	NS	Low

a Values for chloroform substituted due to scarcity of data.
NS Not significant.

References: USEPA, 1979; Howard, 1989; USEPA, 1985.

GERAGHTY & MILLER, INC.
Environmental Services

APPENDIX F

Appendix F

Residential and Municipal Water Quality

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VII
324 EAST ELEVENTH STREET
KANSAS CITY, MISSOURI - 64106

APR 02 1984

Mr. Al Moore
Director Environmental Health
Scott County Health Department
428 Western Avenue
Davenport, Iowa 52801

Dear Mr. Moore:

Jackie Hall of your Department has advised me that you were provided with analytical data on water samples collected and analyzed for the Aluminum Company of America (ALCOA) Davenport Works facility. Said samples were collected from several private wells in the vicinity of the ALCOA site, from the Mississippi River, and from the Davenport municipal water supply. Analyses of the samples were paid for by ALCOA as a service to owners and users of those water supplies to assure them that these supplies had not been contaminated by releases from the ALCOA site.

Ms. Hall has requested the opinion of the Environmental Protection Agency (EPA) regarding the significance of the levels of contaminants reported by the analytical data on these samples. ALCOA has provided me with a copy of the data and information provided to your department. In order to provide you with an opinion regarding the significance of this data I have consulted with the EPA Drinking Water Branch.

None of the Primary or Secondary Drinking Water Standards are exceeded in either the private or public water supplies sampled. Nor do the reported concentrations of contamination appear to pose a significant or unreasonable threat to public health if actually present in the water supplies.

The concentrations reported for inorganic metals appear to be within normal ranges. Two of the private wells contained methylene chloride. It is possible that these concentrations are the result of laboratory contamination of the glassware in which the samples were collected. The laboratory which analyzed these samples does use methylene chloride for cleaning glassware.

Chloroform was found in the Davenport municipal water supply. We suspect that the chloroform may be the result of the reaction of chlorine used to disinfect the municipal water supply with organic material present in the untreated water. This has been an occasional problem with other chlorinated water supplies, especially with those supplies that utilize surface sources of water.

Regardless of their presence in the water supplies methylene chloride, chloroform and metals are not primary constituents of the wastes previously disposed in ALCOA's lagoon. Sampling of the lagoon and the environment by both ALCOA and EPA have consistently shown the principal contaminant to be polychlorinated biphenyls (PCBs). We note that no PCBs were found in any of the samples collected by ALCOA. In addition EPA had previously sampled and analyzed water from the Davenport municipal supply and from the Mississippi River and did not find any PCBs.

In summary, based on our present information we find no evidence in any of this data that releases from the ALCOA site have contaminated either the private or the municipal water supplies. Please contact me at (816) 374-6864 if you have any other questions regarding the ALCOA Site.

Sincerely,

David V. Crawford

David V. Crawford
Project Officer
Waste Management Branch
Air and Waste Management Division

cc: Joe Chandler, IDWAWM

The University of Iowa
Iowa City, Iowa 52242

Hygienic Laboratory
(319) 353-5990

1847

JEP

June 5, 1984

Mr. Lawrence E. Barker
Administrator
Scott County Health Department
Bicentennial Bldg., 5th Floor
428 Western Avenue
Davenport, Iowa 52801

Dear Mr. Barker:

I am responding to your request to Mr. Gene Ronald regarding evaluation of the analytical data for wells in the vicinity of Alcoa's Riverdale plant. This data is reviewed for environmental significance only with no interpretation given as to any health effects that may be caused by any contaminants found in any of the wells.

The total organic carbon (TOC) and chemical oxygen demand (COD) values appear to be slightly high compared to what normally would be found in groundwater samples. I don't think this is any cause for alarm at this time. The inorganic priority pollutant detection limits which are listed in Exhibit II are not low enough to meet the Safe Drinking Water Act requirements for cadmium, chromium, lead, selenium and silver. It is therefore difficult to determine whether those constituents are present at the levels specified as maximum contamination levels (MCL) by the National Interim Primary Drinking Water Regulations.

The following summarizes the MCL values and the quoted detection limits for those contaminants:

	MCL	Detection limit stated
Cadmium	0.01 mg/L	0.02 mg/L
Chromium	0.05	0.1
Lead	0.05	0.2
Selenium	0.01	0.05
Silver	0.05	0.06

Considering the above stated qualifications there seems to be no abnormal environmental contamination of the water supplies at the time of sampling. I hope this information is of value to you. Please feel free to call if you have any questions.

Sincerely,

Roger C. Splinter, Ph.D.
Associate Director

RCS/lc

Beling Laboratories
1001 - 16th Street
Moline, Illinois 61265
Phone 309 / 757-9800

Laboratory Report

Date December 6, 1983

Received November 9 & 14, 1978

Lab No. 4614-19,26

Residential Well Sampling

Mr. M.K. Sonksen
Aluminum Company of America
P.O. Box 3567
Davenport, Iowa 52808

	SAMPLE DESCRIPTION	COD	FLOURIDE	NITRATE NITROGEN	TOC
7	Mississippi River Water	25 mg/l	0.28 mg/l	1.26 mg/l	22.3 mg/l
6	Davenport City Water	13	1.06	1.69	14.8
2	Mr. Hargis	12	0.39	0.22	49.9
1	Mr. Lowell Harris	8.2	0.26	0.14	42.8
3	Mr. Max Horsey	8.7	0.32	1.42	29.6
4	Lisa Showalter	9.1	0.21	0.22	29.4
5	Patricia Dahms	3.5	0.25	0.919	1.9

Jeffrey A. Wasson

SCOTT COUNTY HEALTH DEPARTMENT

LAWRENCE E. BARKER, ADMINISTRATOR

BICENTENNIAL BLDG. 5TH FLOOR
428 WESTERN AVE.
DAVENPORT, IOWA 52801
(319) 326-8618

SEAL OF THE COUNTY OF SCOTT IOWA

AL MOORE
Environmental Health Director

CARMINE ROCCO
Disease Prevention and Health Promotion Director

MARY HELFRICH
Office Manager

September 21, 1984

TO: Whom It May Concern

FROM: Lawrence E. Barker LEB
Administrator, Scott County Health Department

RE: Riverdale Private Water Well Sampling Project of November 1983 by the Aluminum Company of America

The intent of this report is to address the expressed concerns of Riverdale residents relating to the analysis of water samples taken from local wells by Alcoa. The company provided six pages of analytical data to the Scott County Health Department for our review. One hundred nineteen individual parameters were analyzed on five residential wells, the Davenport municipal water supply, and the Mississippi River water, by an independent laboratory. Alcoa consulted with and requested the assistance of this Department in presenting the information.

It was felt that the interests of the public could best be served by soliciting the expertise of the University of Iowa Hygienic Laboratory and the United States Environmental Protection Agency in evaluating and interpreting the data. In so doing, they were asked to determine the significance of the results. The following is a composite of their responses:

Robert C. Splinter, Ph.D
Associate Director
University of Iowa Hygienic Laboratory
Iowa City, Iowa

"Considering the above-stated qualifications, there seems to be no abnormal environmental contamination of the water supplies at the time of sampling."

David V. Crawford
Project Officer
Waste Management Branch
Air and Waste Management Division
U.S. Environmental Protection Agency
Kansas City, Missouri

"None of the Primary or Secondary Drinking Water Standards are exceeded in either the private or public water supplies sampled nor do the reported concentrations of contamination appear to pose a significant or unreasonable threat to public health if actually present in the water supplies."

"The concentrations reported for nonorganic metals appear to be within normal ranges."

"Sampling of the lagoon and the environment by both Alcoa and EPA have consistently shown the principal contaminant to be polychlorinated biphenyls (PCB's)."

"We note that no PCB's were found in any of the samples collected by Alcoa. In addition, EPA had previously sampled and analyzed water from the Davenport municipal supply and from the Mississippi River and did not find any PCB's.

"In summary, based on our present information we find no evidence in any of this data that releases from the Alcoa site have contaminated either the private or the municipal water supplies."

Therefore, it is the opinion of the Scott County Health Department that the comments expressed by these individuals are sufficient to summarize and conclude this project.

If you have any questions concerning this correspondence, please contact Christopher A. Wightman, R.S., Public Health Sanitarian II, at 326-8618.

LEB/CAW:mc

ALUMINUM COMPANY OF AMERICA
P.O. BOX 3567
DAVENPORT, IOWA 52808
(319) 359-2000

1984 March 15

David Crawford
Waste Management Branch
Environmental Protection Agency
325 E. 11th St.
Kansas City, MO 64106

RE: RESIDENTIAL WELL WATER ANALYSIS

Dear Mr. Crawford:

I have attached the well water analysis data we shared with the Scott County Board of Health on March 6, 1984. We were asking for the Board of Health's assistance in making the data presentable for review with the private well owner. Jackie Hall contacted you to seek more information on certain chemicals, which resulted in your phone call to me today.

A quick synopsis of the attached material:

> Chemical compounds listed on attached Exhibit II are all the chemicals that were tested in each well with the corresponding detection limit of the analysis equipment.
>
> The front page summary sheet lists all the chemicals found in any well. All the other compounds not listed were found to be below the detection limit. (N.D.)
>
> The hand drawn map shows the relative location of the 5 residential wells in relation to the plant's western boundry (Bellingham Road).

As I mentioned in our phone conversation, the presence of Methylene chloride in two samples is believed to be a carryover from cleaning the sampling equipment.

If there are any questions concerning this material, please contact me at (319) 359-2236 or Marshall Sonksen at (319) 359-2754.

Yours truly

G.O. Pratt/jch

G. O. Pratt, Jr.
Manager
Safety, Environmental and Energy

GOP:jch

noocc: M. K. Sonksen
W. L. Crawford/T. M. Wilkinson/R. L. Burns
M. E. Kommer, Pittsburgh

RESIDENTIAL WELL SAMPLING

Sample Identifier:	R.WELL A Nov. 83	R.WELL B Nov. 83	R. Well C Nov. 83	R. Well D Nov. 83	R. Well E Nov. 83	City Water Nov. 83	River Water Nov. 83
INORGANICS (MG/L) PRIORITY POLLUTANTS							
Copper, Total	N.D.	N.D.	N.D.	N.D.	N.D.	0.24	N.D.
Zinc, Total	0.58	0.04	0.24	0.75	0.77	N.D.	N.D.
Phenols, Total	0.02	0.01	0.01	0.01	N.D.	0.01	0.01
VOLATILE ORGANICS (µG/L)							
Chloroform	N.D.	N.D.	N.D.	N.D.	N.D.	52	N.D.
Methylene Chloride	12	N.D.	N.D.	N.D.	28	N.D.	N.D.
BASE NEUTRAL (µG/L) EXTRACTABLE ORGANICS							
BIS (2-Ethylehexyl) Phthalate	N.D.	N.D.	N.D.	N.D.	N.D.	N.D.	15
OTHER (MG/L)							
TOC	42.8	49.9	29.6	29.4	1.9	14.8	22.3
Flouride	0.26	0.39	0.32	0.21	0.25	1.06	0.28
Nitrate Nitrogen	0.14	0.22	1.42	0.22	0.919	1.69	1.26
COD	8.2	12	8.7	9.1	3.5	13	25

4-03-06.2

ATTACHMENTS TO LETTER TO CRAWFORD – USEPA DTD MARCH 15

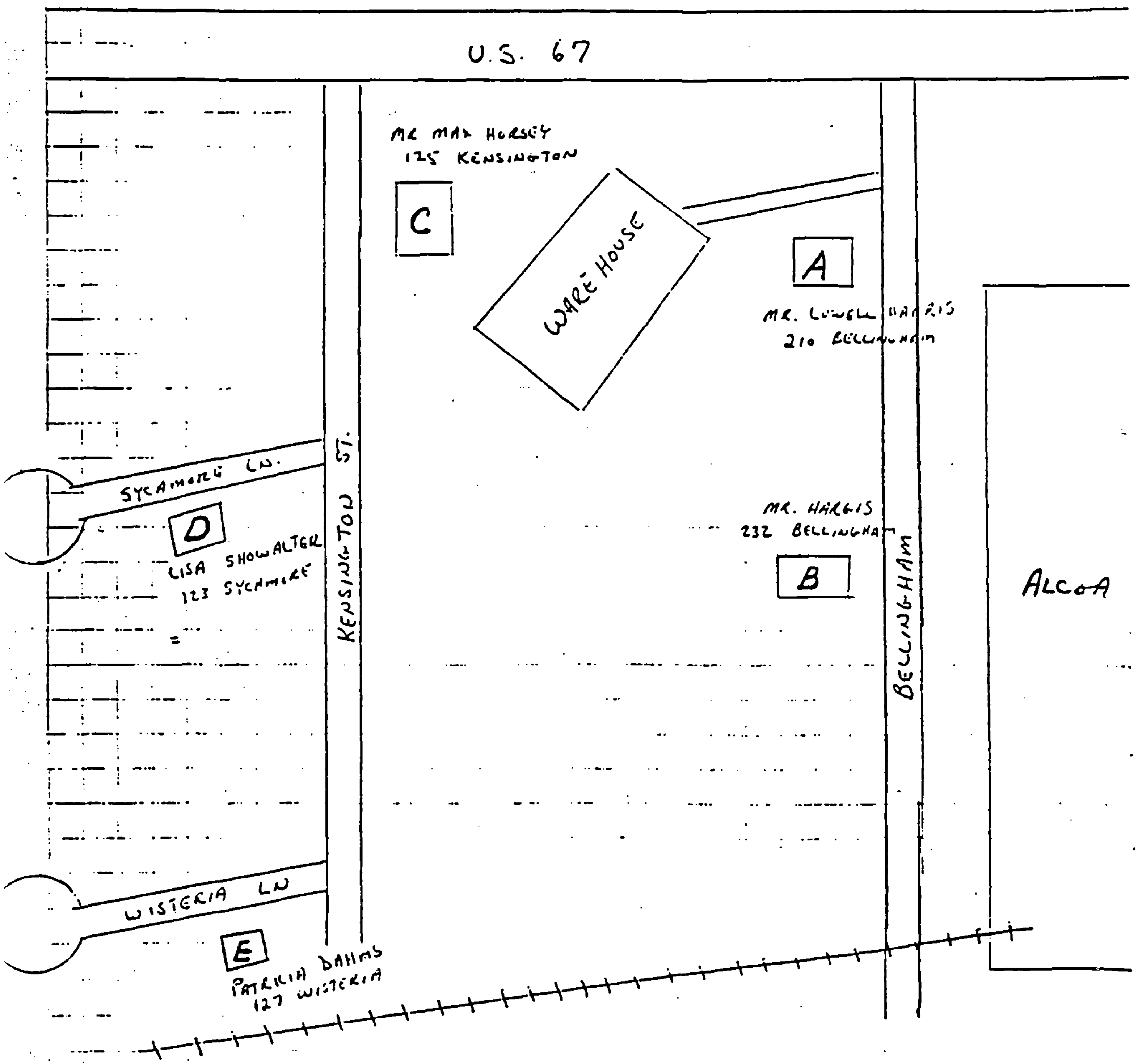
COMPUTATION SHEET

Beling Consultants

PROFESSIONAL ENGINEERS

MOLINE, IL PEORIA, IL ROCKFORD, IL JOLIET, IL
BURLINGTON IA BETTENDORF, IA AURORA CO

BY Jew	DATE 12-7-83	PROJECT Alcoa Residential Monitoring	JOB NO. 33635
CHK'D BY	DATE	Sampling Locations	SHEET NO. OF SHEETS



Beling Consultants
LABORATORY REPORT

September 29, 1989

This well north of plant on otherside of the highway

Mr. Frank Harrington
Aluminum Company of America
P. O. Box 3567
Davenport, Iowa 52808

Lab No.: 25961
Received: September 18, 1989
Collected: September 18, 1989
Collection point: Crissey House

VOLATILE FRACTION

	mg/L
Chloromethane	<0.01
Bromomethane	<0.01
Vinyl Chloride	<0.01
Chloroethane	<0.01
Methylene Chloride	<0.005
Trichlorofluoromethane	<0.005
1,1-Dichloroethene	<0.005
1,1-Dichloroethane	<0.005
1,2-Dichloroethene (total)	<0.005
Chloroform	<0.005
1,2-Dichloroethane	<0.005
1,1,1-Trichloroethane	<0.005
Carbon Tetrachloride	<0.005
Bromodichloromethane	<0.005
1,2-Dichloropropane	<0.005
cis-1,3-Dichloropropene	<0.005
Trichloroethene	<0.005
Dibromochloromethane	<0.005
2-Chloroethyl vinyl ether	<0.005
1,1,2-Trichloroethane	<0.005
Benzene	<0.005
trans-1,3-Dichloropropene	<0.005
Bromoform	<0.005
Tetrachloroethene	<0.005
1,1,2,2-Tetrachloroethane	<0.005
Toluene	<0.005
Chlorobenzene	<0.005
Ethylbenzene	<0.005

Jeffrey A. Wasson

Beling Consultants
LABORATORY REPORT
September 28, 1989

Aluminum Company of America
Lab No.: 25961
Page 2

BASE NEUTRALS/ACID EXTRACTABLES

	mg/L
N-Nitrosodimethylamine	<0.01
Aniline	<0.01
Phenol	<0.01
bis(2-Chloroethyl)ether	<0.01
2-Chlorophenol	<0.01
1,3-Dichlorobenzene	<0.01
1,4-Dichlorobenzene	<0.01
Benzyl alcohol	<0.01
1,2-Dichlorobenzene	<0.01
2-Methylphenol	<0.01
bis(2-Chloroisopropyl)ether	<0.01
4-Methylphenol	<0.01
N-Nitroso-di-n-propylamine	<0.01
Hexachloroethane	<0.01
Nitrobenzene	<0.01
Isophorone	<0.01
2-Nitrophenol	<0.01
2,4-Dimethylphenol	<0.01
Benzoic acid	<0.05
bis(2-Chloroethoxy)methane	<0.01
2,4-Dichlorophenol	<0.01
1,2,4-Trichlorobenzene	<0.01
Naphthalene	<0.01
4-Chloroaniline	<0.01
Hexachlorobutadiene	<0.01
4-Chloro-3-methylphenol	<0.01
2-Methylnaphthalene	<0.01
Hexachlorocyclopentadiene	<0.01
2,4,6-Trichlorophenol	<0.01
2,4,5-Trichlorophenol	<0.05
2-Chloronaphthalene	<0.01
2-Nitroaniline	<0.05
Dimethylphthalate	<0.01
Acenaphthylene	<0.01
2,6-Dinitrotoluene	<0.05
3-Nitroaniline	<0.05
Acenaphthene	<0.01
2,4-Dinitrophenol	<0.05
4-Nitrophenol	<0.05
Dibenzofuran	<0.01
2,4-Dinitrotoluene	<0.05
Diethylphthalate	<0.01

Jeffrey A. Wasson

Beling Consultants
LABORATORY REPORT
September 28, 1989

Aluminum Company of America
Lab No.: 25961
Page 3

BASE NEUTRALS/ACID EXTRACTABLES (cont.)

	mg/L
4-Chlorophenyl-phenylether	<0.01
Fluorene	<0.01
4-Nitroaniline	<0.05
4,6-Dinitro-2-methylphenol	<0.05
N-Nitrosodiphenylamine	<0.01
Azobenzene	<0.01
4-Bromophenyl-phenylether	<0.01
Hexachlorobenzene	<0.01
Pentachlorophenol	<0.05
Phenanthrene	<0.01
Anthracene	<0.01
Di-n-butylphthalate	<0.01
Fluoranthene	<0.01
Pyrene	<0.01
Butylbenzylphthalate	<0.01
3,3'-Dichlorobenzidine	<0.02
Benzo(a)anthracene	<0.01
Chrysene	<0.01
Bis(2-Ethylhexyl)phthalate	<0.01
Di-n-octylphthalate	<0.01
Benzo(b)fluoranthene	<0.01
Benzo(k)fluoranthene	<0.01
Benzo(a)pyrene	<0.01
Indeno(1,2,3-cd)pyrene	<0.01
Dibenz(a,h)anthracene	<0.01
Benzo(g,h,i)perylene	<0.01

Jeffrey A. Wasson

Beling Consultants
LABORATORY REPORT
September 28, 1989

Aluminum Company of America
Lab No.: 25961
Page 4

PESTICIDE/PCB FRACTION

	mg/L
Alpha-BHC	<0.00005
Beta-BHC	<0.00005
Delta-BHC	<0.00005
Gamma-BHC (Lindane)	<0.00005
Heptachlor	<0.00005
Aldrin	<0.00005
Heptachlor Epoxide	<0.00005
Endosulfan I	<0.00005
Dieldrin	<0.00010
4,4'-DDE	<0.00010
Endrin	<0.00010
Endosulfan II	<0.00010
4,4'-DDD	<0.00010
Endosulfan Sulfate	<0.00010
4,4'-DDT	<0.00010
Methoxychlor	<0.0005
Endrin Ketone	<0.00010
Chlordane	<0.0005
Toxaphene	<0.001
Aroclor 1016	<0.0005
Aroclor 1221	<0.0005
Aroclor 1232	<0.0005
Aroclor 1242	<0.0005
Aroclor 1248	<0.0005
Aroclor 1254	<0.001
Aroclor 1260	<0.001

Jeffrey A. Wasson

Beling Consultants
LABORATORY REPORT
September 28, 1989

Aluminum Company of America
Lab No.: 25961
Page 5

Antimony, mg/L	<0.2
Arsenic, mg/L	<0.002
Beryllium, mg/L	<0.005
Cadmium, mg/L	<0.005
Chromium, mg/L	<0.05
Copper, mg/L	<0.02
Lead, mg/L	<0.1
Mercury, mg/L	<0.0002
Nickel, mg/L	<0.04
Selenium, mg/L	<0.002
Silver, mg/L	<0.01
Thallium, mg/L	<0.1
Zinc, mg/L	0.994

Jeffrey A. Wasson

Beling Consultants
LABORATORY REPORT
September 28, 1989

Mr. Frank Harrington
Aluminum Company of America
P. O. Box 3567
Davenport, Iowa 52808

Lab No.: 25960
Received: September 18, 1989
Collected: September 18, 1989
Collection point: Kelley Cottage

VOLATILE FRACTION

	mg/L
Chloromethane	<0.01
Bromomethane	<0.01
Vinyl Chloride	<0.01
Chloroethane	<0.01
Methylene Chloride	<0.005
Trichlorofluoromethane	<0.005
1,1-Dichloroethene	<0.005
1,1-Dichloroethane	<0.005
1,2-Dichloroethene (total)	<0.005
Chloroform	<0.005
1,2-Dichloroethane	<0.005
1,1,1-Trichloroethane	<0.005
Carbon Tetrachloride	<0.005
Bromodichloromethane	<0.005
1,2-Dichloropropane	<0.005
cis-1,3-Dichloropropene	<0.005
Trichloroethene	<0.005
Dibromochloromethane	<0.005
2-Chloroethyl vinyl ether	<0.005
1,1,2-Trichloroethane	<0.005
Benzene	<0.005
trans-1,3-Dichloropropene	<0.005
Bromoform	<0.005
Tetrachloroethene	<0.005
1,1,2,2-Tetrachloroethane	<0.005
Toluene	<0.005
Chlorobenzene	<0.005
Ethylbenzene	<0.005

Jeffrey A. Warner

Beling Consultants
LABORATORY REPORT
September 28, 1989

Aluminum Company of America
Lab No.: 25960
Page 2

BASE NEUTRALS/ACID EXTRACTABLES

	mg/L
N-Nitrosodimethylamine	<0.01
Aniline	<0.01
Phenol	<0.01
bis(2-Chloroethyl)ether	<0.01
2-Chlorophenol	<0.01
1,3-Dichlorobenzene	<0.01
1,4-Dichlorobenzene	<0.01
Benzyl alcohol	<0.01
1,2-Dichlorobenzene	<0.01
2-Methylphenol	<0.01
bis(2-Chloroisopropyl)ether	<0.01
4-Methylphenol	<0.01
N-Nitroso-di-n-propylamine	<0.01
Hexachloroethane	<0.01
Nitrobenzene	<0.01
Isophorone	<0.01
2-Nitrophenol	<0.01
2,4-Dimethylphenol	<0.01
Benzoic acid	<0.05
bis(2-Chloroethoxy)methane	<0.01
2,4-Dichlorophenol	<0.01
1,2,4-Trichlorobenzene	<0.01
Naphthalene	<0.01
4-Chloroaniline	<0.01
Hexachlorobutadiene	<0.01
4-Chloro-3-methylphenol	<0.01
2-Methylnaphthalene	<0.01
Hexachlorocyclopentadiene	<0.01
2,4,6-Trichlorophenol	<0.01
2,4,5-Trichlorophenol	<0.05
2-Chloronaphthalene	<0.01
2-Nitroaniline	<0.05
Dimethylphthalate	<0.01
Acenaphthylene	<0.01
2,6-Dinitrotoluene	<0.05
3-Nitroaniline	<0.05
Acenaphthene	<0.01
2,4-Dinitrophenol	<0.05
4-Nitrophenol	<0.05
Dibenzofuran	<0.01
2,4-Dinitrotoluene	<0.05
Diethylphthalate	<0.01

Jeffrey A. Wasson

Aluminum Company of America
Lab No.: 25960
Page 3

BASE NEUTRALS/ACID EXTRACTABLES (cont.)

	mg/L
4-Chlorophenyl-phenylether	<0.01
Fluorene	<0.01
4-Nitroaniline	<0.05
4,6-Dinitro-2-methylphenol	<0.05
N-Nitrosodiphenylamine	<0.01
Azobenzene	<0.01
4-Bromophenyl-phenylether	<0.01
Hexachlorobenzene	<0.01
Pentachlorophenol	<0.05
Phenanthrene	<0.01
Anthracene	<0.01
Di-n-butylphthalate	<0.01
Fluoranthene	<0.01
Pyrene	<0.01
Butylbenzylphthalate	<0.01
3,3'-Dichlorobenzidine	<0.02
Benzo(a)anthracene	<0.01
Chrysene	<0.01
Bis(2-Ethylhexyl)phthalate	<0.01
Di-n-octylphthalate	<0.01
Benzo(b)fluoranthene	<0.01
Benzo(k)fluoranthene	<0.01
Benzo(a)pyrene	<0.01
Indeno(1,2,3-cd)pyrene	<0.01
Dibenz(a,h)anthracene	<0.01
Benzo(g,h,i)perylene	<0.01

Jeffrey A. Wasson

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LABORATORY REPORT
September 28, 1989

Aluminum Company of America
Lab No.: 25960
Page 4

PESTICIDE/PCB FRACTION

	mg/L
Alpha-BHC	<0.00005
Beta-BHC	<0.00005
Delta-BHC	<0.00005
Gamma-BHC (Lindane)	<0.00005
Heptachlor	<0.00005
Aldrin	<0.00005
Heptachlor Epoxide	<0.00005
Endosulfan I	<0.00005
Dieldrin	<0.00010
4,4'-DDE	<0.00010
Endrin	<0.00010
Endosulfan II	<0.00010
4,4'-DDD	<0.00010
Endosulfan Sulfate	<0.00010
4,4'-DDT	<0.00010
Methoxychlor	<0.0005
Endrin Ketone	<0.00010
Chlordane	<0.0005
Toxaphene	<0.001
Aroclor 1016	<0.0005
Aroclor 1221	<0.0005
Aroclor 1232	<0.0005
Aroclor 1242	<0.0005
Aroclor 1248	<0.0005
Aroclor 1254	<0.001
Aroclor 1260	<0.001

Jeffrey A. Wasson

Beling Consultants
LABORATORY REPORT
September 28, 1989

Aluminum Company of America
Lab No.: 25960
Page 5

Antimony, mg/L	<0.2
Arsenic, mg/L	<0.002
Beryllium, mg/L	<0.005
Cadmium, mg/L	0.008
Chromium, mg/L	<0.05
Copper, mg/L	0.06
Lead, mg/L	<0.1
Mercury, mg/L	<0.0002
Nickel, mg/L	<0.04
Selenium, mg/L	<0.002
Silver, mg/L	0.02
Thallium, mg/L	<0.1
Zinc, mg/L	0.303

Jeffrey A. Wasson

IOWA-AMERICAN WATER COMPANY
AN AMERICAN WATER WORKS SYSTEM COMPANY

October 9, 1989
File No. 230-383

Mr. Craig S. Stevens
Staff Scientist, Hydrogeologist
Geraghty & Miller, Inc.
6209 Riverside Drive, Suite One South
Dublin, OH 43017

Dear Mr. Stevens:

I have enclosed analytical results for the selected priority pollutants from raw water samples collected from the Mississippi River. Tetrachloroethylene and trichloroethylene were the only two compounds that were detected during the period of 1982-1988.

Hopefully, these anlaytical results will provide helpful water quality data for Alcoa's hydrogeological report. We would appreciate being copied on any report that our data is utilized.

Should you have any questions, please feel free to call. Let us know if we can be of further assistance.

Sincerely,

Joel R. Mohr

Joel R. Mohr
Assistant Production Superintendent-Water Quality

Enclosure

230 EAST SECOND STREET
P.O. BOX 979 DAVENPORT, IOWA 52805 (319) 324-3264

OCTOBER 9,1989

IOWA-AMERICAN WATER COMPANY, QUAD CITIES DISTRICT

MISSISSIPPI RIVER WATER QUALITY - SELECTED PRIORITY POLLUTANTS

SAMPLE LOCATION	COMPOUND	MCL OR MCLG*	UNIT	1989	1988	1987	1986	1985	1984	1983	1982	1981	1980
RAW WATER -	CHLOROETHANE		MG/L		<0.0005	<0.001	<0.001	<0.001	<0.001				
MISSISSIPPI RIVER					<0.0005	<0.001	<0.001	<0.001	<0.001				
	1,1-DICHLOROETHANE		MG/L		<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001			
					<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
	1,1-DICHLOROETHENE	0.007	MG/L		<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01		
	(1,1-DICHLOROETHYLENE)				<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
	1,2-DICHLOROETHANE	0.005	MG/L		<0.0005	<0.001	<0.001	<0.001		<0.001	<0.01		
					<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
	TRANS-1,2-DICHLOROETHYLENE	0.07*	MG/L		<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01		
					<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
	TETRACHLOROETHENE		MG/L		<0.0005	<0.001	<0.001	4.267	<0.001	<0.001	<0.01		
	(TETRACHLOROETHYLENE)				<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
	TOLUENE	2.0*	MG/L		<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001			
					<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
	TRICHLOROETHYLENE	0.005	MG/L		<0.0005	<0.001	<0.001	<0.001	<0.001	0.0066	<0.01		
					<0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001		
	VINYL CHLORIDE	0.002	MG/L		<0.0005	<0.001	<0.001	<0.001	<0.001				
					<0.0005	<0.001	<0.001	<0.001	<0.001				

AUGUST 1[illegible].1989

IOWA-AMERICA[illegible] COMPANY, QUAD CITIES DISTRICT

DRINKING WATER SURVEILLANCE PROGRAM - POLYCHLORINATED BIPHENYLS (PCB)

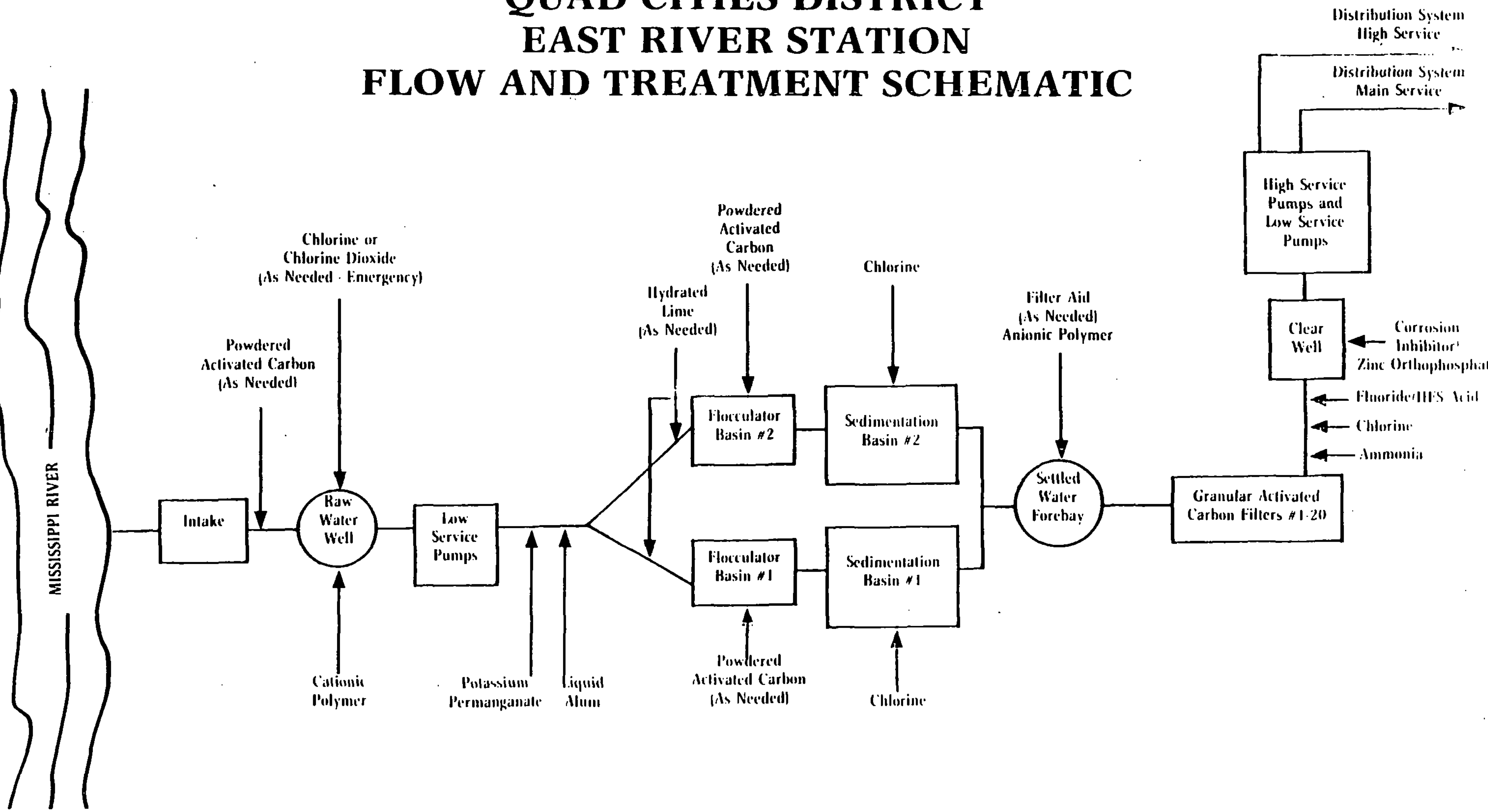
STARTED ANALYZING FOR PCB [illegible]UARY 1984

NOTE THE FOLLOWING PCB COMPOUNDS ARE MONITORED: PCB 1016, PCB 1221, PCB 1232, PCB 1242, PCB 1248, PCB 1254

SAMPLE LOCATION	PARAMETER	PROPOSED MCL OR MCLG	UNIT	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	AVERAGE	MAXIMUM	MINIMUM	NO. OF TESTS
RAW WATER - MISSISSIPPI RIVER																			
1984	PCB	PMCL 0.0005	MG/L				<0.001						<0.001			0	0	0	2
1985		MCLG 0						<0.001					<0.001			0	0	0	2
1986							<0.001						<0.001			0	0	0	2
1987							<0.001						<0.001			0	0	0	2
1988							<0.001						<0.001			0	0	0	2
1989																			0
FILTER INFLUENT																			
1984	PCB	PMCL 0.0005	MG/L	<0.001					<0.001		<0.001				<0.001	0	0	0	4
1985		MCLG 0		<0.001					<0.001		<0.001				<0.001	0	0	0	4
1986				<0.001					<0.001		<0.001				<0.001	0	0	0	4
1987				<0.001					<0.001						<0.001	0	0	0	3
1988				<0.001					<0.001		<0.001				<0.001	0	0	0	4
1989				<0.001												0	0	0	1
FILTER EFFLUENT																			
1984	PCB	PMCL 0.0005	MG/L	<0.001					<0.001		<0.001				<0.001	0	0	0	4
1985		MCLG 0		<0.001					<0.001		<0.001				<0.001	0	0	0	4
1986				<0.001					<0.001		<0.001				<0.001	0	0	0	4
1987				<0.001					<0.001		<0.001				<0.001	0	0	0	4
1988				<0.001					<0.001		<0.001				<0.001	0	0	0	4
1989				<0.001												0	0	0	1
PLANT EFFLUENT																			
1984	PCB	PMCL 0.0005	MG/L				<0.001						<0.001			0	0	0	2
1985		MCLG 0						<0.001					<0.001			0	0	0	2
1986							<0.001						<0.001			0	0	0	2
1987							<0.001						<0.001			0	0	0	2
1988							<0.001						<0.001			0	0	0	2
1989							<0.001									0	0	0	1
DISTRIBUTION SYSTEM																			
1984	PCB	PMCL 0.0005	MG/L																0
1985		MCLG 0																	0
1986																			0
1987								<0.001								0	0	0	1
1988																			0
1989																			0

63 TOTAL

IOWA-AMERICAN WATER COMPANY
QUAD CITIES DISTRICT
EAST RIVER STATION
FLOW AND TREATMENT SCHEMATIC



IOWA-AMERICAN WATER COMPANY

"A Tradition of Quality Service to the American Heartland"

Iowa-American Water Company was formed in 1987, as the result of a merger between Davenport Water Company and its sister company, Clinton Water Works Company. While the "Iowa-American" name is relatively new, the two utilities which created it have been dedicated to quality water service for over a century. The new name symbolizes the service provided in the State of Iowa as well as participation in the American Water Works Company, Inc., Iowa-American's parent corporation.

The American Water System, which is the largest group of investor-owned water utilities in the country, has been in the business of providing water service to the greater-Davenport area since 1927, when it purchased Davenport Water Company.

Iowa-American's Quad Cities District provides water for homes, manufacturing and fire protection to over 130,000 residents in Davenport, Bettendorf, Riverdale and Panorama Park. Every day, on the average, 18 million gallons of water is supplied to customers, 50 percent of which is pumped to residential customers for drinking, cooking and cleaning. The other half is used for industrial and commercial purposes.

As a public utility regulated under the laws of the State of Iowa, Iowa-American's rates are set and approved by the Iowa Utilities Board.

The Mississippi River is the district's sole water supply. Purification and initial distribution of water into the system occurs at the treatment plant located one mile upstream from Lock and Dam #15 on the bank of-the river. Treatment includes flocculation, sedimentation, chlorination and filtration processes before the final product is distributed to consumers throughout the district's over 500-mile pipeline distribution system.

Iowa-American's in-house testing laboratory conducts about 140 water quality analyses daily. Iowa-American, as with all other public water suppliers, must meet stringent water quality guidelines established by federal, state and local agencies. As a subsidiary of the American Water System, the company is fortunate to have access to a state-of-the-art laboratory in Belleville, Illinois, where extensive research and complex water analyses are conducted.

Water quality is a top priority for Iowa-American Water Company. The company is proud of its dedicated and professional personnel. In the future, the company will continue to build on its tradition of quality service to the American heartland providing customers with the highest quality water product available, at the lowest reasonable cost.

APPENDIX G

Appendix G

Slug Test Data

TABLE OF PARAMETERS USED TO CALCULATE HYDRAULIC CONDUCTIVITY BASED ON SLUG TEST DATA

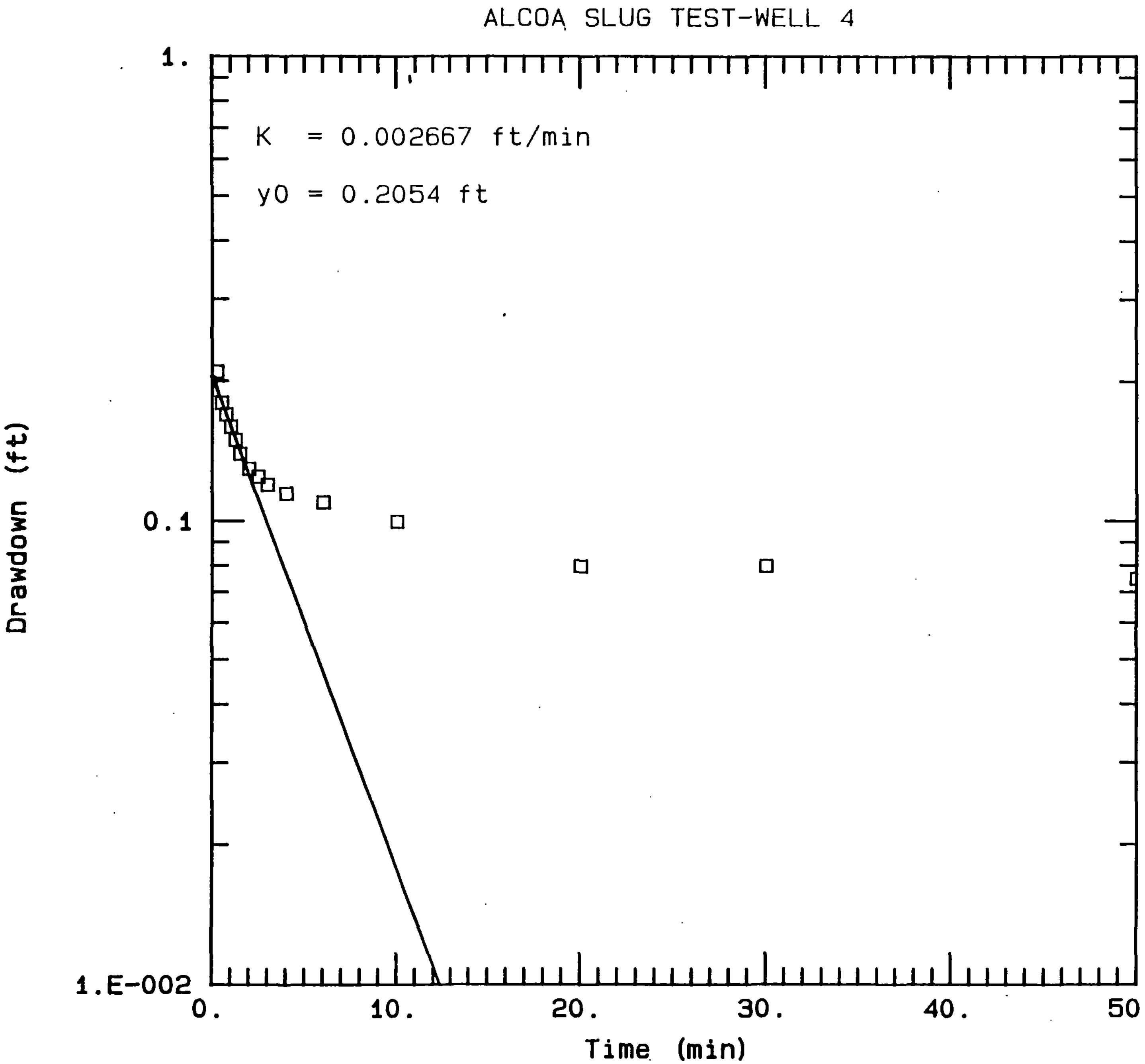
WELL	r_c (ft)	r_w (ft)	L^A (ft)	L^B (ft)	H (ft)
GM-4	.260	.458	10	5.6	5.6
GM-6	.260	.458	10	4.6	4.6
AS	.288	.458	10	3.7	3.7
GM-12	.288	.458	10	3.5	3.5
GM-14	.195	.333	5	2.5	2.5
GM-16	.120	.166	17	11	11

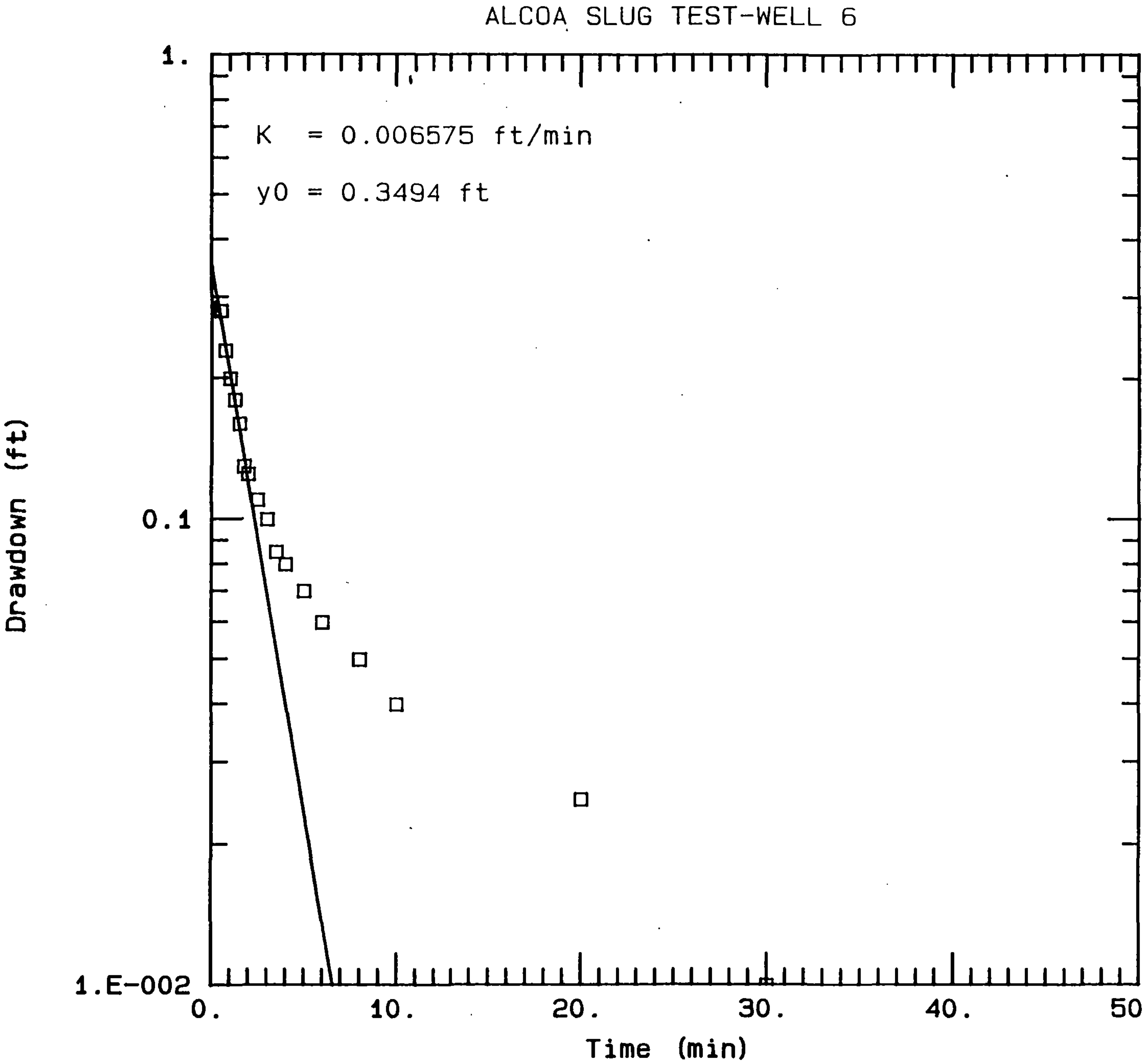
Notes:

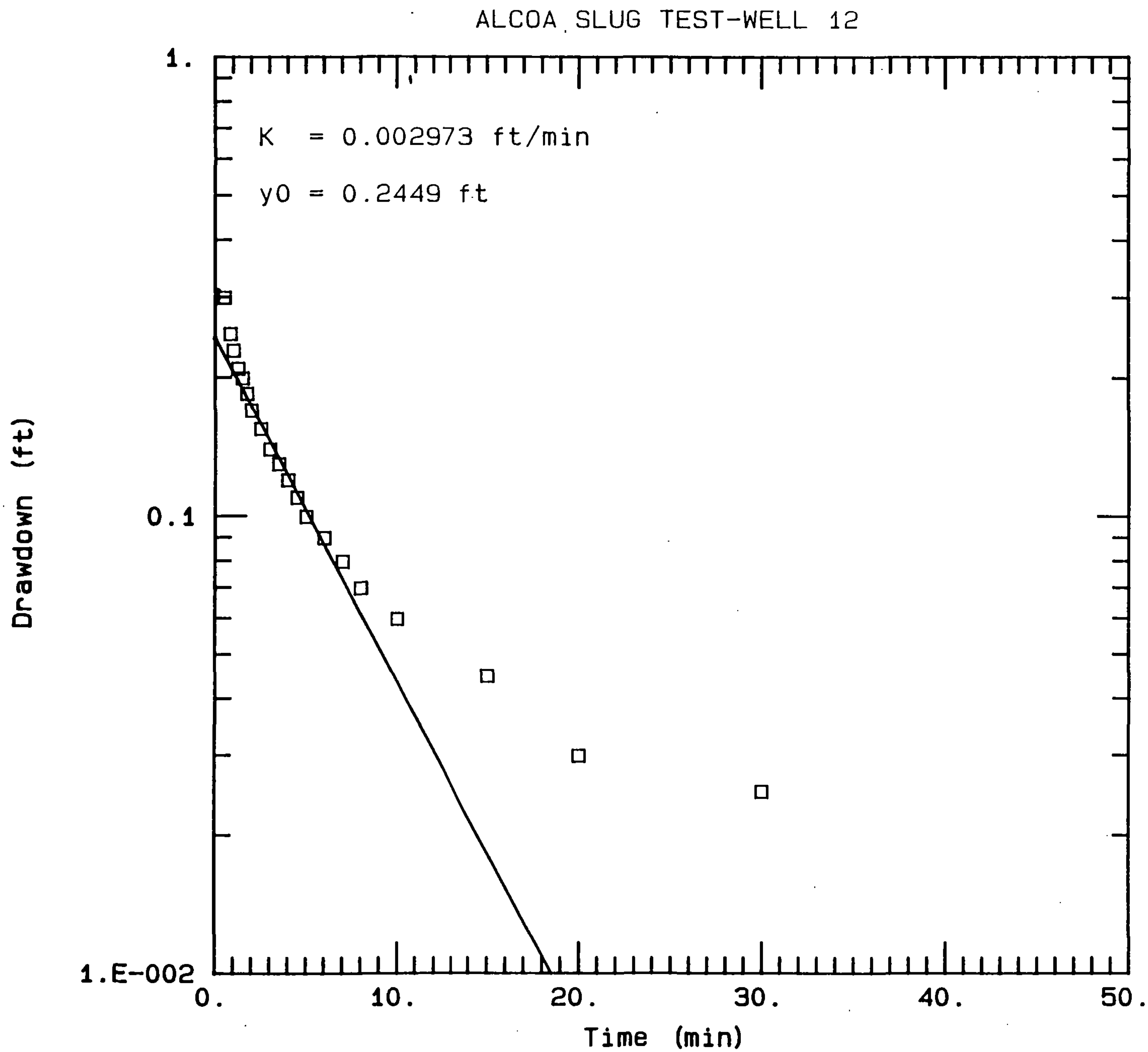
LB: Length of Screen and/or Open Borehole Below Water Table which equals H. L^B Value Used for all Calculations.

L^A: Total Length of Screen and/or Open Borehole.

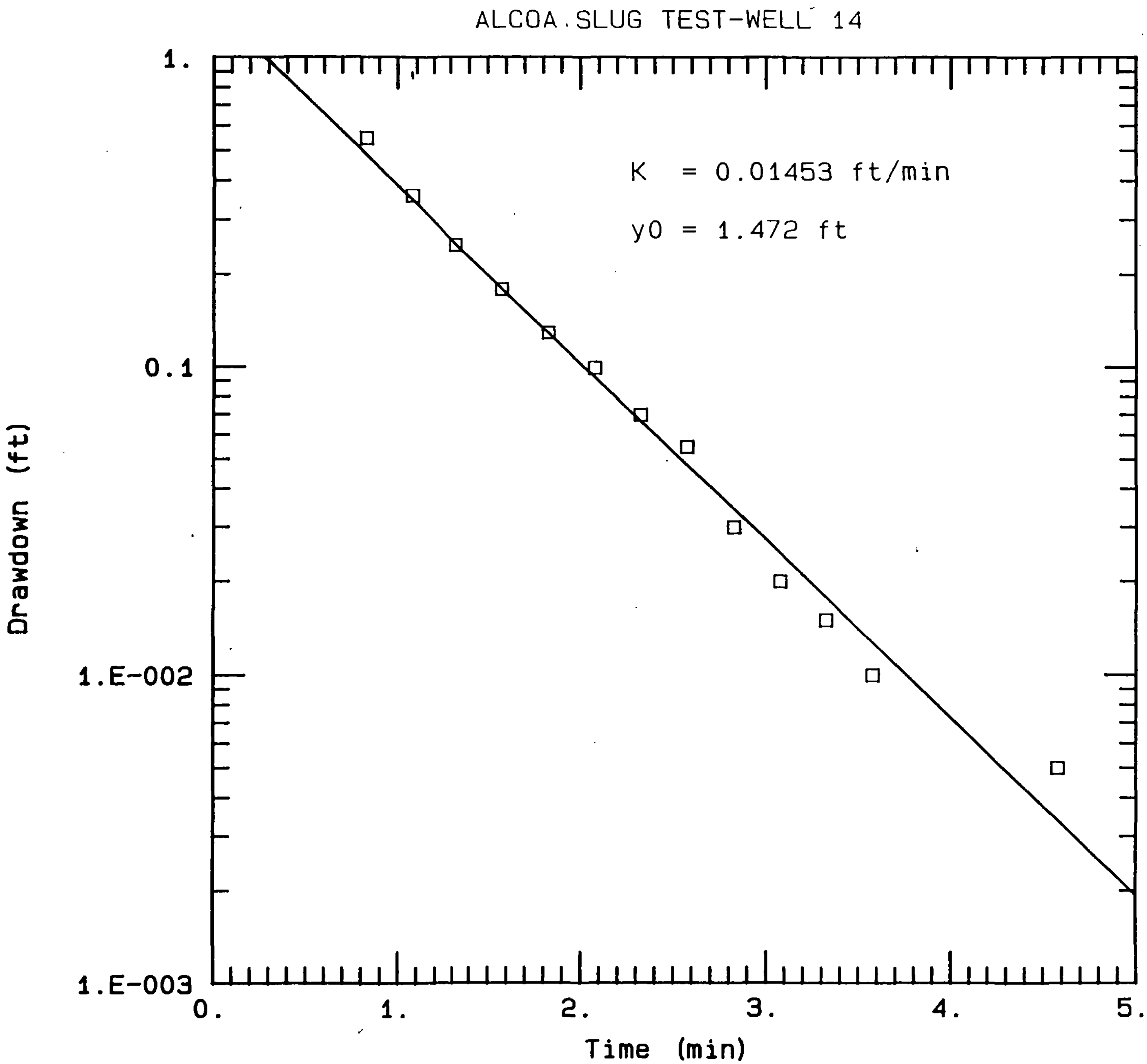
slug2.tbl

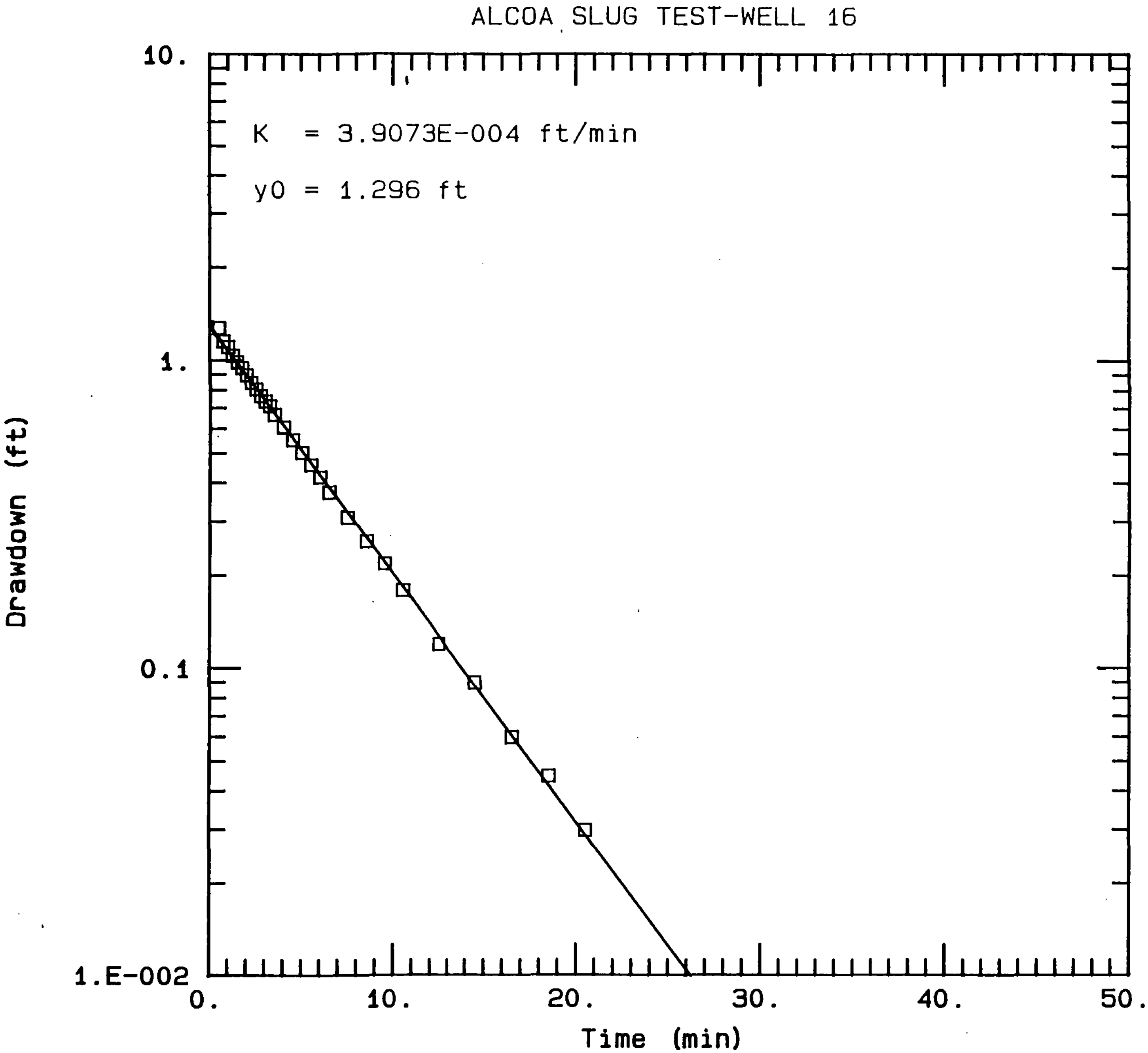

ALCOA SLUG TEST-WELL 4
K = 0.002667 ft/min
y0 = 0.2054 ft
Drawdown (ft)
Time (min)
1.
0.1
1.E-002
0.
10.
20.
30.
40.
50.

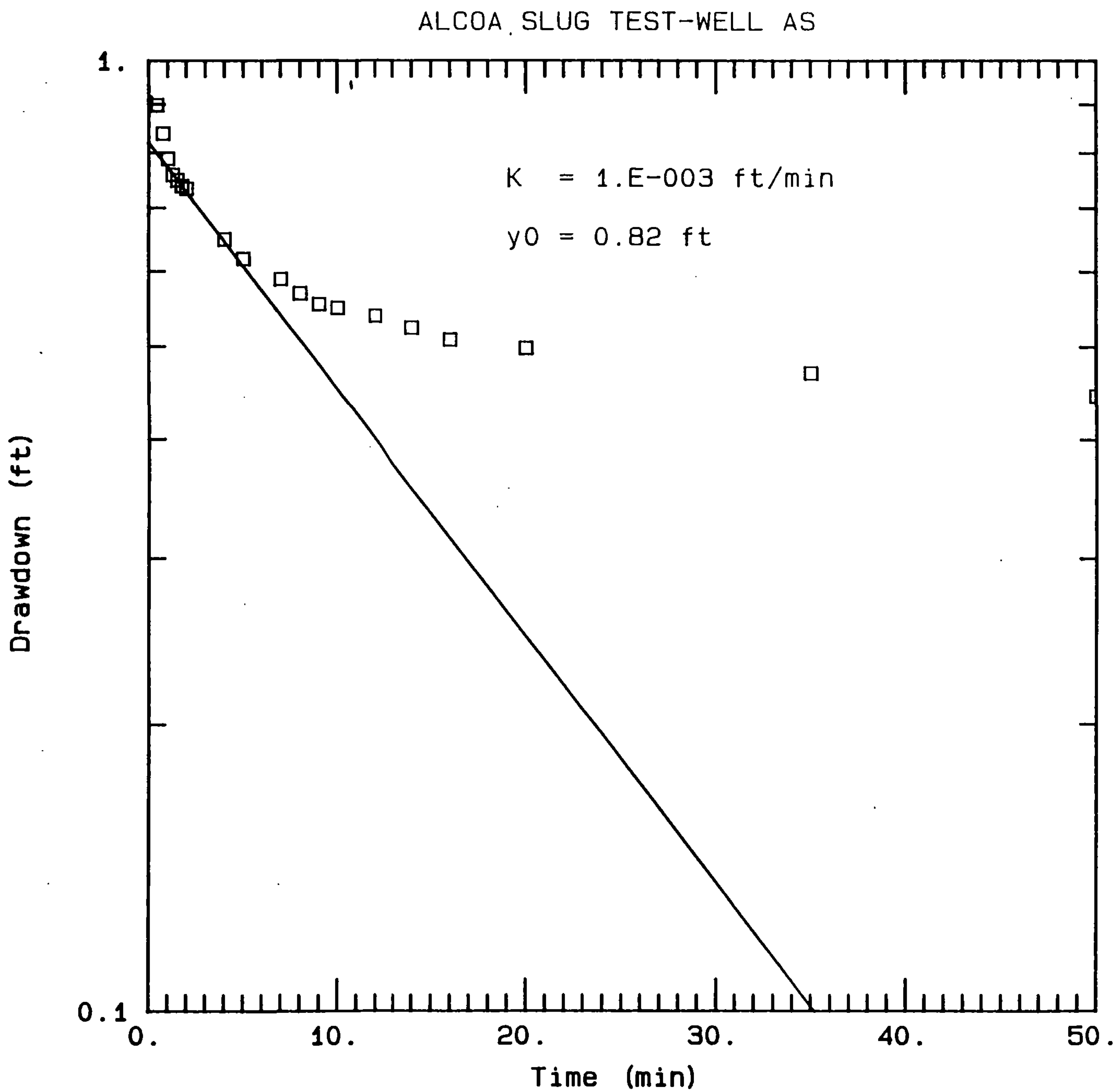

ALCOA SLUG TEST-WELL 6
K = 0.006575 ft/min
y0 = 0.3494 ft
Drawdown (ft)
1.
0.1
1.E-002
0.
10.
20.
30.
40.
50.
Time (min)



ALCOA SLUG TEST-WELL 12
K = 0.002973 ft/min
y0 = 0.2449 ft
1.
0.1
1.E-002
Drawdown (ft)
0.
10.
20.
30.
40.
50.
Time (min)


ALCOA SLUG TEST-WELL 14
K = 0.01453 ft/min
y0 = 1.472 ft
1.
0.1
1.E-002
1.E-003
Drawdown (ft)
0.
1.
2.
3.
4.
5.
Time (min)


ALCOA SLUG TEST-WELL 16
K = 3.9073E-004 ft/min
y0 = 1.296 ft
10.
1.
0.1
1.E-002
0.
10.
20.
30.
40.
50.
Time (min)
Drawdown (ft)


ALCOA SLUG TEST-WELL AS
K = 1.E-003 ft/min
y0 = 0.82 ft
Drawdown (ft)
1.
0.1
Time (min)
0.
10.
20.
30.
40.
50.

ALCOA (DAVENPORT, IOWA) SLUG TEST DATA

WELL GM-4

Elapsed Time (Minutes)	Depth to Water (Feet)	Residual Head (Feet)
0.00	16.09	.00
.25	16.30	.21
.50	16.27	.18
.75	16.26	.17
1.00	16.25	.16
1.25	16.24	.15
1.50	16.23	.14
2.00	16.22	.13
2.50	16.215	.125
3.00	16.21	.12
4.00	16.205	.115
6.00	16.20	.11
10.00	16.19	.10
20.00	16.17	.08
30.00	16.17	.08
50.00	16.165	.075
70.00	16.16	.07
130.00	16.15	.06
345.00	16.11	.02
408.00	16.105	.015

ALCOA (DAVENPORT, IOWA) SLUG TEST DATA

WELL GM-6

Elapsed Time (Minutes)	Depth to Water (Feet)	Residual Head (Feet)
0.00	17.92	.00
0.50	18.20	.28
0.75	18.15	.23
1.00	18.12	.20
1.25	18.10	.18
1.50	18.08	.16
1.75	18.05	.13
2.00	18.045	.125
2.50	18.03	.11
3.00	18.02	.10
3.50	18.005	.085
4.00	18.00	.08
5.00	17.99	.07
6.00	17.98	.06
8.00	17.97	.05
10.00	17.96	.04
20.00	17.945	.025
30.00	17.93	.01
95.00	17.92	.00

ALCOA (DAVEMPORT, IOWA) SLUG TEST DATA

WELL GM-12

Elapsed Time (Minutes)	Depth to Water (Feet)	Residual Head (Feet)
0.00	14.50	.00
0.50	14.80	.30
0.833	14.75	.25
1.00	14.73	.23
1.25	14.71	.21
1.50	14.70	.20
1.75	14.685	.185
2.00	14.670	.170
2.50	14.655	.155
3.00	14.64	.140
3.50	14.63	.130
4.00	14.62	.120
4.50	14.61	.110
5.00	14.60	.100
6.00	14.59	.090
7.00	14.58	.080
8.00	14.57	.070
10.00	14.56	.060
15.00	14.545	.045
20.00	14.530	.030
30.00	14.525	.025

ALCOA (DAVENPORT, IOWA) SLUG TEST DATA

WELL GM-14

Elapsed Time (Minutes)	Depth to Water (Feet)	Residual Head (Feet)
0.00	12.05	.00
0.833	12.60	.55
1.083	12.41	.36
1.33	12.30	.25
1.58	12.23	.18
1.83	12.18	.13
2.08	12.15	.10
2.33	12.12	.07
2.58	12.105	.055
2.83	12.08	.03
3.08	12.07	.02
3.33	12.065	.015
3.58	12.06	.01
4.58	12.055	.005
6.83	12.05	.00

ALCOA (DAVENPORT, IOWA) SLUG TEST DATA

WELL GM-16

Elapsed Time (Minutes)	Depth to Water (Feet)	Residual Head (Feet)
0.00	11.45	.00
0.50	12.73	1.28
0.75	12.61	1.16
1.00	12.56	1.11
1.25	12.49	1.04
1.50	12.44	.99
1.75	12.40	.95
2.00	12.35	.90
2.25	12.30	.85
2.50	12.26	.81
2.75	12.22	.77
3.00	12.19	.74
3.25	12.165	.715
3.50	12.12	.67
4.00	12.06	.61
4.50	12.005	.555
5.00	11.955	.505
5.50	11.91	.46
6.00	11.87	.42
6.50	11.825	.375
7.50	11.76	.31
8.50	11.71	.26
9.50	11.67	.22
10.50	11.63	.18
12.50	11.57	.12
14.50	11.54	.09
16.50	11.51	.06
18.50	11.495	.045
20.50	11.48	.03

ALCOA (DAVENPORT, IOWA) SLUG TEST DATA

WELL AS

Elapsed Time (Minutes)	Depth to Water (Feet)	Residual Head (Feet)
0.00	16.30	.00
0.417	17.20	.90
0.75	17.14	.84
1.00	17.09	.79
1.25	17.06	.76
1.50	17.05	.75
1.75	17.04	.74
2.00	17.035	.735
2.50	17.00	.700
4.00	16.95	.65
4.50	16.93	.63
5.00	16.92	.62
7.00	16.89	.59
8.00	16.87	.57
9.00	16.855	.555
10.00	16.85	.55
12.00	16.84	.54
14.00	16.825	.525
16.00	16.81	.51
20.00	16.80	.50
35.00	16.77	.47
50.00	16.745	.445
234.00	16.605	.305
313.00	16.570	.27
348.00	16.560	.26

PLATE I.

GEOLOGIC CROSS SECTION OF THE BEDROCK UNITS RECORDED BENEATH THE ALCOA - DAVENPORT PLANT SITE.

Over-sized Document

GERAGHTY & MILLER, INC.